Watershed Management Plan
HUC 10 Watershed # 0306010403

Broad River (Madison County, Georgia)

March 2014

Prepared by the Northeast Georgia Regional Commission's Planning and Government Services Division

with the support of the

Environmental Protection Division of the
Georgia Department of Natural Resources

NEGRC
Northeast Georgia Regional Commission

Georgia Department of Natural Resources

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I. Segment and Watershed Description

The impaired segment of the Broad River (SR 281 to Scull Shoal Creek near Danielsville) is five miles in length and is located in the Savannah River basin in Madison County, Georgia, northwest of the City of Danielsville (Figure 1). The fecal coliform data that listed this segment were collected in 1997 and 1998, and indicated that the segment is partially supporting its designated use of fishing (EPD now only classifies segments as supporting or not supporting, and this segment would now fall under the "not supporting" category). E. coli and fecal coliform data have been collected on a limited basis since 1997-1998. A Total Maximum Daily Load (TMDL) was established for this segment in 2005. Sources of impairment are nonpoint, and are thought to consist primarily of wildlife and animal production, with failing septic systems possibly contributing. The TMDL Implementation Plan developed in 2007 indicates that a 69% reduction in pollutant loading is needed for this segment to meet its designated use of fishing. The Broad River Watershed Association has undertaken E. coli and fecal coliform monitoring in the watershed at various time periods since the late 1990s.

The watershed for the SR 281-to-Scull Shoal Creek segment is 28,022 acres. Primary land uses in the watershed are forestry/logging, crop production, and residential, according to 2004 land use data. Forestry/logging accounts for 45%. The primary source of fecal coliform on forestry land is wildlife, although there may be human sources as well (hunting camps). According to land use data, crop production accounts for 28% of property in the study area.

However, during a windshield survey conducted in association with this work, animal production was observed much more often than crop production. It is possible that most of the land classified in the land use data as crop production is in fact used for livestock grazing. Stakeholders discussed this issue while developing the Broad River Watershed Improvement Plan (WIP, a precursor to this Watershed Management Plan) ~~first advisory meeting~~, and they agreed that most land characterized as "crop production" is likely used for livestock purposes. Also, the trend in Madison County has been for cropland to be given over to animal production. Animal production in the watershed consists primarily of pasture for cattle and horses, and poultry and egg production. Residential land accounts for 18% of the watershed. All of the residences in the watershed are served by individual septic systems.

Due to the potential discrepancy in the above-referenced land use data, this document also provides a map of land cover in the watershed (Figure 2), which shows different types of environments and may prove more useful for understanding the true nature of the watershed's physical situation.

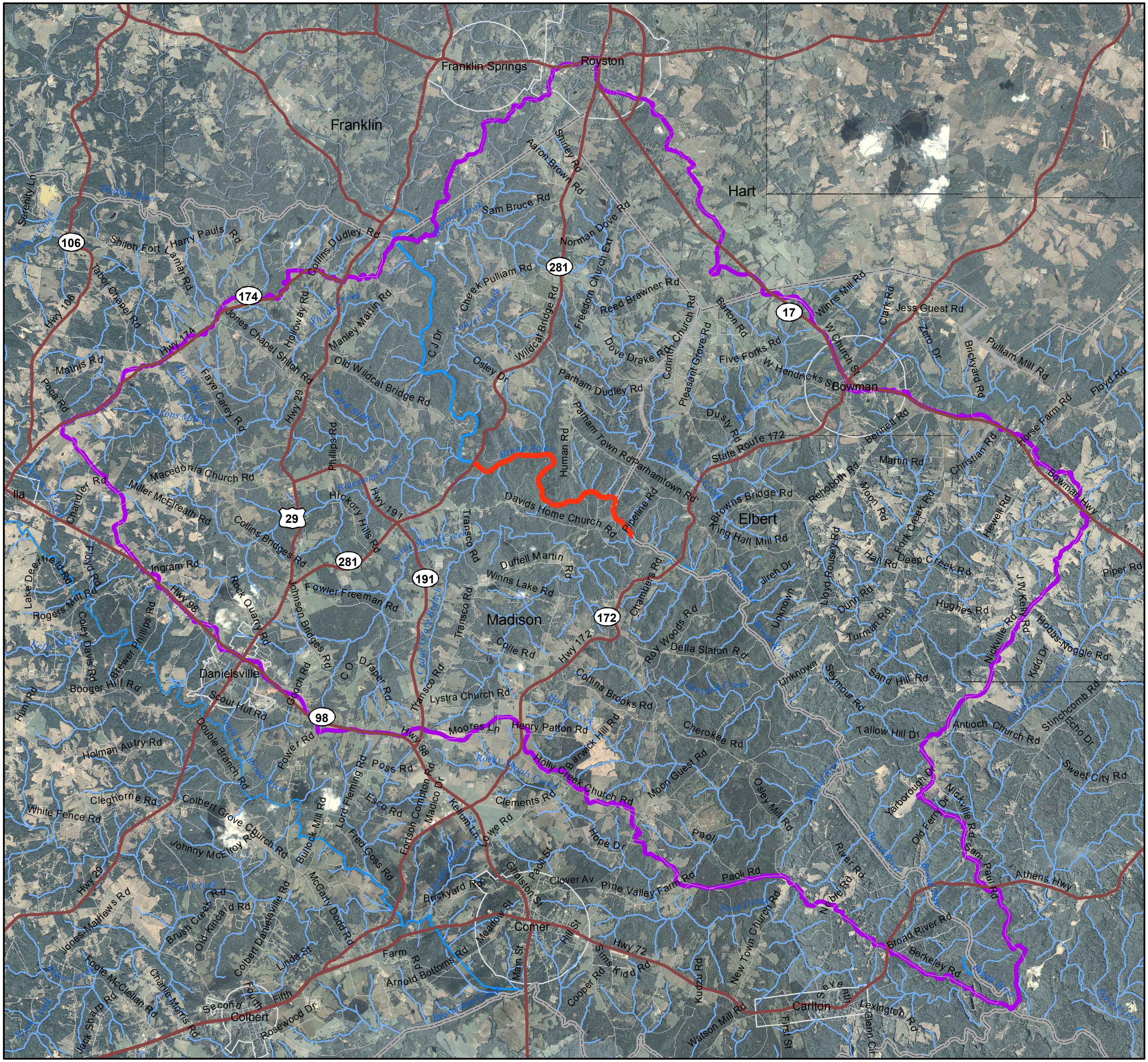
No water pollution control facilities or known point sources exist along the impaired segment.

Madison County has adopted a soil erosion and sedimentation control ordinance that addresses nonpoint source pollution on newly-developed lands, as well as a stormwater ordinance to limit and control post-development stormwater runoff. The county's river corridor protection ordinance was adopted in 1993. Madison County also has an ordinance allowing for the construction of conservation subdivisions; that ordinance requires at least 50% of the land in these developments to be kept as greenspace and be put into a permanent conservation easement. The remaining land will be developed with the same number of residences that would be allowed on the entire property under standard zoning regulations. Additionally, Madison County has adopted a groundwater recharge protection ordinance. In 2009, Madison County adopted an ordinance to increase the riparian buffer limit on state waters from 25' to 50', with a 100' buffer on the Broad, South Fork, and Hudson rivers.

Keep Madison County Beautiful led the 2005 and 2006 Rivers Alive cleanup events on the Broad River in Oglethorpe, Madison, and Elbert Counties, and continues to promote these events. The Broad River Watershed Association is active in Madison County and conducts educational, outreach, and monitoring events within the watershed. Madison County is located in the Oconee River Resource Conservation and Development Council (RC&D) region. The RC&D has led EPA 319(h)-funded programs in other counties in the region, but none have been active in this watershed.

Figure 1

Watershed Orientation



- HUC 10 Watershed # 0306010403
- Impaired Segment
- Streams
- State Highways
- Roads
- Cities

Aerial Photo Date: Summer, 2010 (NAIP 2010)

N / W / E / S

Miles

0.5 0 0.5 1

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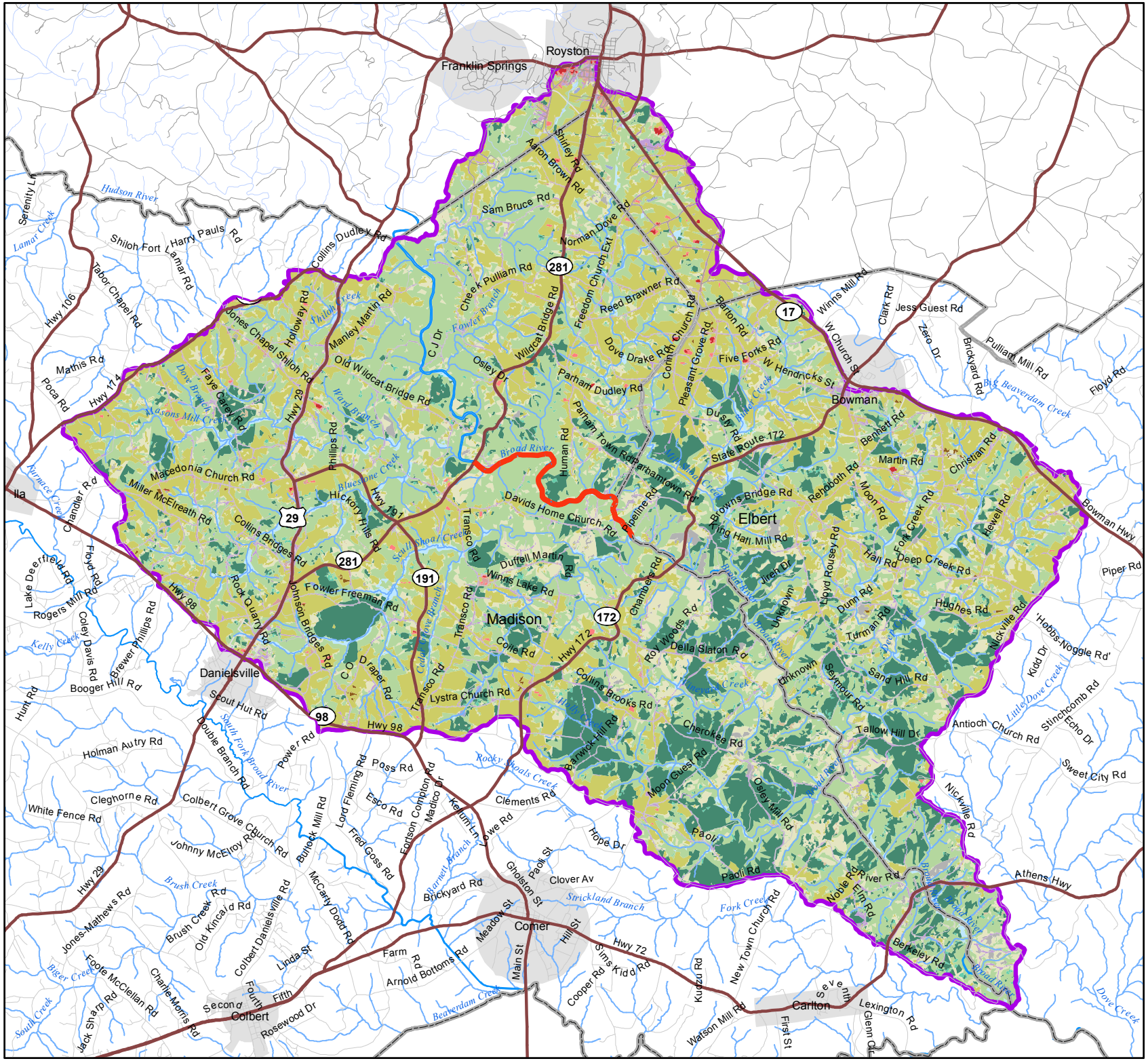

Figure 2

Land Cover

Landcover

- Developed, Low Intensity
- Developed, Medium Intensity
- Developed, High Intensity
- Developed, Open Space
- Cultivated Crops
- Hay/Pasture
- Deciduous Forest
- Mixed Forest
- Evergreen Forest
- Herbaceuous
- Shrub/Scrub
- Woody Wetlands
- Open Water
- Barren Land
- Emergent Herbaceous Wetlands
- HUC 10 Watershed #0306010403
- Impaired Segment
- Streams
- State Highways
- Roads
- Cities

Land Use/Land Cover Date: February 20, 2007.

N
W E
S

Miles

0.5 0 0.5 1

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II. Water Quality Impairments and Total Maximum Daily Loads

The impaired segment is five miles long and flows from SR 281 to the confluence with Scull Shoal Creek. The pollutant of concern is fecal coliform, and the impairment is based on the above-referenced data obtained in the 1997-1998 period. The segment was placed on the Georgia 303(d) list of impaired water bodies as partially supporting its designated use of fishing. (That listing would now be characterized as "not supporting.")

The table below provides the water quality sampling data for the Broad River that precipitated its listing on the Georgia 303(d) list.

Table 1: Broad River at SR 281, 1997 Sampling Data

Date	Observed Fecal Coliform (counts/100 ml)	Date	Observed Fecal Coliform (counts/100 ml)	Date	Observed Fecal Coliform (counts/100 ml)
1.16.97	5895	7.15.97	560	11.26.97	330
2.11.97	460	7.29.97	330	12.9.97	70
3.11.97	460	8.4.97	80	12.17.97	330
4.21.97	410	8.12.97	220	12.23.97	1100
5.6.97	700	9.9.97	230		
6.10.97	375	10.21.97	490		

Source: United States Geologic Survey data form (process date 6/27/99), as referenced in Sampling Quality Assurance Plan for the Broad River (HUC 10 #0306010403), August 2008

A TMDL was established by the Georgia Department of Natural Resources' Environmental Protection Division for two impaired segments of the Broad River in 2005. The associated report, *Total Maximum Daily Load Evaluation for Thirty-Two Streams in the Savannah River Basin for Fecal Coliform*, indicates that a 69% reduction in fecal coliform loads is required for this stream to achieve standards for its designated use.

Table 2: 2005 TMDL Evaluation Data

Stream Segment	Current Load (counts/30 days)	TMDL Components					Percent Reduction
		WLA (counts/30 days)	WLAsw (counts/30 days)	LA (counts/30 days)	MOS (counts/30 days)	TMDL (counts/30 days)	
Broad River – SR 281 to Scull Shoal Creek near Danielsville	1.13E+16			3.12E+15	3.46E+14	3.46E+15	69

As of the beginning of this Watershed Management Plan development process, the source of the impairment was unknown. The TMDL Implementation Plan speculated that the source could be wildlife, animal production, and/or failing septic systems. Preliminary WMP sampling data revealed several "hot spots." Initial discussions with stakeholders helped identify several potential contamination sources that merit further investigation. In an effort to better isolate potential sources, new sites were added to the sampling inventory and others were removed from the current sampling list.

III. Visual Surveys and Targeted Watershed Monitoring

A visual field survey was conducted in February 2009 and further site visits were conducted in 2011 and 2013. Water quality sampling was initiated in May 2011 under a Targeted Monitoring Plan that identified seven locations for E. coli monitoring under the plan.

Monitoring was recommenced in March 2013 with a new set of sampling locations, and has taken place at each location monthly in an effort to geographically isolate the major sources of impairment. Due to the presence of consistent "hot spots" and other areas where readings did not appear to be a concern, the sampling site locations evolve over time.

Escherichia coli are rod-shaped bacteria that live in the lower intestines of warm-blooded mammals. They are necessary for the proper digestion of food, but their presence in surface water indicates fecal contamination. E. coli belongs to a group of bacteria (some of which are harmful) known as fecal coliform bacteria. E. coli itself cannot cause illness unless it is introduced into an open wound or the urinary tract.

Table 3: Sampling Stations

Station Number	General Location	Latitude	Longitude	Sample Parameters
1A	Broad R. at US 29	34.23977	-83.17921	*E. coli*
1	Broad R. at SR 281 – access at Broad River Outpost *(GAEPD site)*	34.180868	-83.145808	*E. coli*
1B	Broad R. at SR 172	34.15651	-83.08291	*E. coli*
2	Shiloh Cr. at Manley Martin Rd. (downstream)	34.220484	-83.176817	*E. coli*
3	Trib. to Shiloh Cr. downstream of US 29	34.219803	-83.187942	*E. coli*
3A	Shiloh Cr. at US 29 (downstream)	34.220035	-83.189993	*E. coli*
4	Shiloh Cr. at Holloway Rd. (upstream)	34.212195	-83.201639	*E. coli*
4A1	Shiloh Cr. upstream of Holloway Rd. (downstream site at farm)	34.214642	-83.203933	*E. coli*
4A2	Shiloh Cr. upstream of Holloway Rd. (upstream site at farm)	34.214642	-83.203933	*E. coli*
4B	Shiloh Cr. along Long Peeples Rd.	34.218019	-83.192211	*E. coli*
4C	Branch of Shiloh Cr. at Holloway Rd. (ditch draining wetland)	34.212236	-83.201519	*E. coli*
5	Scull Shoal Cr. at Davids Home Church Rd. (downstream)	34.155858	-83.099936	*E. coli*
6	Little Scull Shoal Cr. at Duffell Martin Rd. (upstream)	34.152515	-83.121335	*E. coli*
6A	Little Scull Shoal Cr. at Winns Lake Rd.	34.147525	-83.128144	*E. coli*

Table 3: Sampling Stations				
Station Number	**General Location**	**Latitude**	**Longitude**	**Sample Parameters**
7	Scull Shoal Cr. at Transco Rd. (upstream)	34.158695	-83.149622	*E. coli*
7A	Scull Shoal Cr. upstream of Transco Rd.	34.158769	-83.149478	*E. coli*
7A Alt.	Scull Shoal Cr. at SR 191 (upstream)	34.158519	-83.164258	*E. coli*
8	Little Scull Shoal Cr. at Coile Rd.	34.13284	-83.13693	*E. coli*
9	Little Scull Shoal Cr. at Lystra Church Rd.	34.11873	-83.14754	*E. coli*

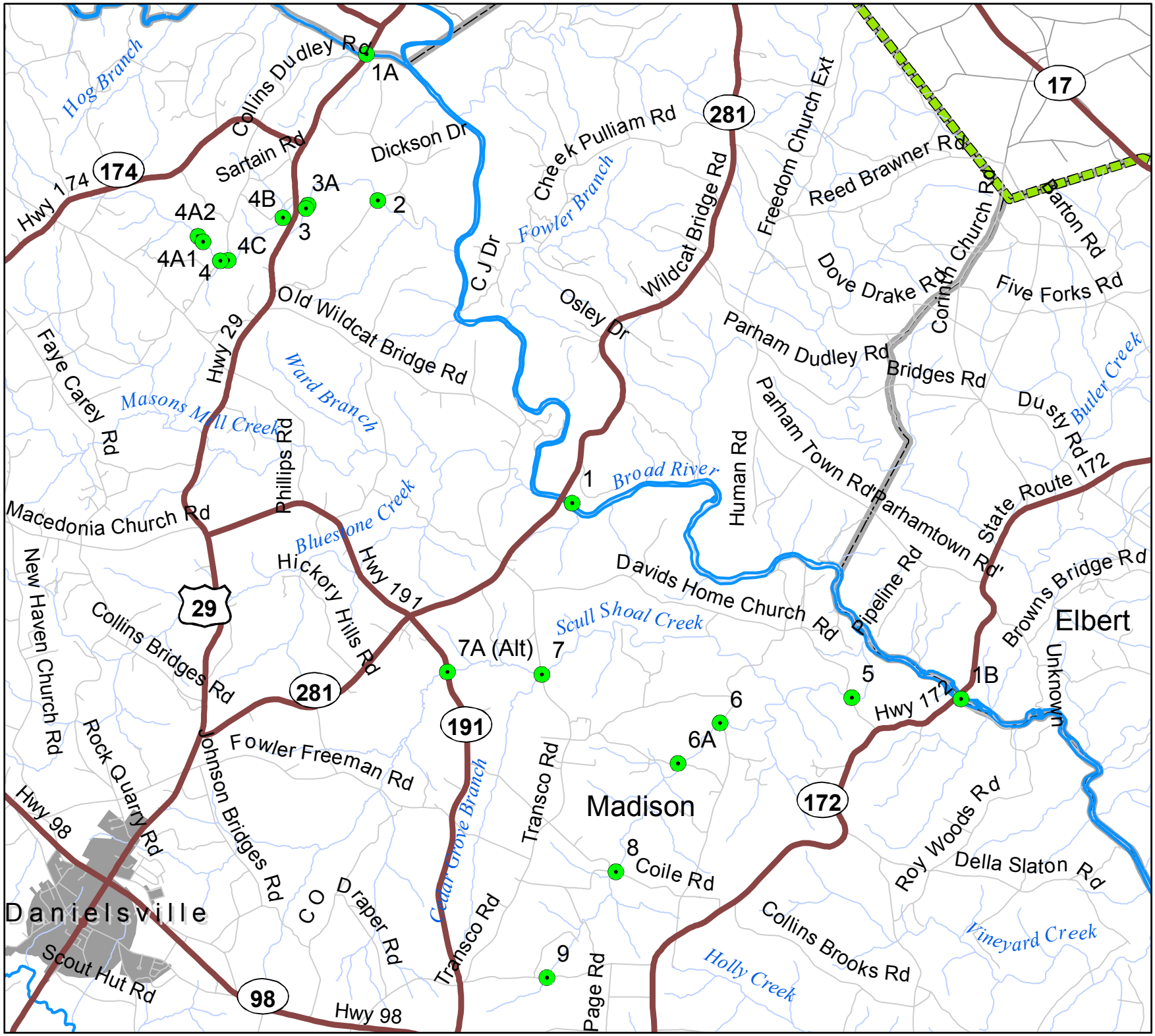

Figure 3

Sampling Locations

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Water quality sampling provided the following data for each of the sampling locations (figures in colony-forming units, CFU):

Site	3/13	5/13	6/13	7/13	9/13	9/13	10/13	11/13	12/13
1A						67	133	233	200
1	200	200	233	133	633	200	100	233	166
1B						167	100	33	200
2	866	800	800	700	833	1470	567	547	633
3	233	666	367	600	1533	667	633	367	367
3A	67	566	367	433	333	500	700	433	667
4	1	200	267	100	166	67	333	233	200
4A1	1	500	567	633	333				
4A2	100	366	100	133	200				
4B	67	566	667						
4C	133	266	367	233	467	267	533	167	100
5	366	666	500	166	1133	300	267	167	667
6	1166	1400	1467	333	2233	400	433	400	2833
6A	800	1700	1467	1000	2033	167	567	267	3067
7	200	300	633	300	500				
7A Alt	233	333	233	500	300				
8						833	800	700	5500
9						1	67	233	333

US EPA fecal coliform assumes 60% of a fecal coliform most probable number (MPN) is E. coli. Calculating this ratio, as shown below, yields results that can be evaluated against the fecal coliform standard.

May - October

Geometric means not to exceed 200 MPN/100 ml

No individual sample exceeding 4,000 MPN/100 ml

November - April

Geometric mean not to exceed 1,000 MPN/100 ml

No individual sample exceeding 4,000 MPN/100 ml.

Site	3/13	5/13	6/13	7/13	9/13	9/13	10/13	11/13	12/13
1A						112	222	388	333
1	333	333	388	222	1055	333	167	388	277
1B						278	167	55	333
2	1443	1333	1333	1167	1388	2450	945	912	1055
3	388	1110	612	1000	2555	1112	1055	612	612
3A	112	943	612	722	555	833	1167	722	1112
4	2	333	445	167	277	112	555	388	333
4A1	2	833	945	1055	555				
4A2	167	610	167	222	333				
4B	112	943	1112						
4C	222	443	612	388	778	445	888	278	167
5	610	1110	833	277	1888	500	445	278	1112
6	1943	2333	2445	555	3722	667	722	667	4722
6A	1333	2833	2445	1667	3388	278	945	445	5112
7	333	500	1055	500	833				
7A Alt	388	555	388	833	500				
8						1388	1333	1167	9167
9						2	112	388	555

IV. Identification and Ranking of Significant Sources of Impairments

The TMDL Implementation Plan for the Broad River identifies the following sources of contamination:

Table 4: TMDLIP Potential Source Ranking for the Broad River

POTENTIAL SOURCES	ESTIMATED EXTENT OF CONTRIBUTION		ESTIMATED PORTION OF CONTRIBUTION		*IMPACT RATING (A X B)*
	Comments	***Rating (A)***	**Comments**	***Rating (B)***	
Wildlife	Forestry/logging is 45% of watershed land use	3	Forestry/logging adjacent to stream segment	3	9
Animal Production	Animal production is 7% of watershed according to land use data, but likely to be a lot more	3	Animal production in close proximity to tributaries but not TMDL segment	1	3
Failing Septic Systems	Residential is 18% land use	1	Several residential parcels adjacent to TMDL segment	1	1
Illegal Dumping		UNK		UNK	UNK

Based on data obtained and analyzed under the WMP development process, the table above seems to underestimate Animal Production as a significant concern, particularly regarding the statement, “Animal production in close proximity to tributaries but not TMDL segment.” While it is true that the areas surrounding the tributaries are the primary location of animal production, their impact on the watershed should not be discounted or underrepresented. Additionally, stakeholders indicate that the land cover data from which the previous table is derived are likely in error. They note that a large part of the watershed that was previously characterized as forestry/logging is actually agricultural (in fact, they suggest that the plurality of land in the watershed is agricultural, with much of this based in animal production).

The following Revised Potential Source Ranking is presented:

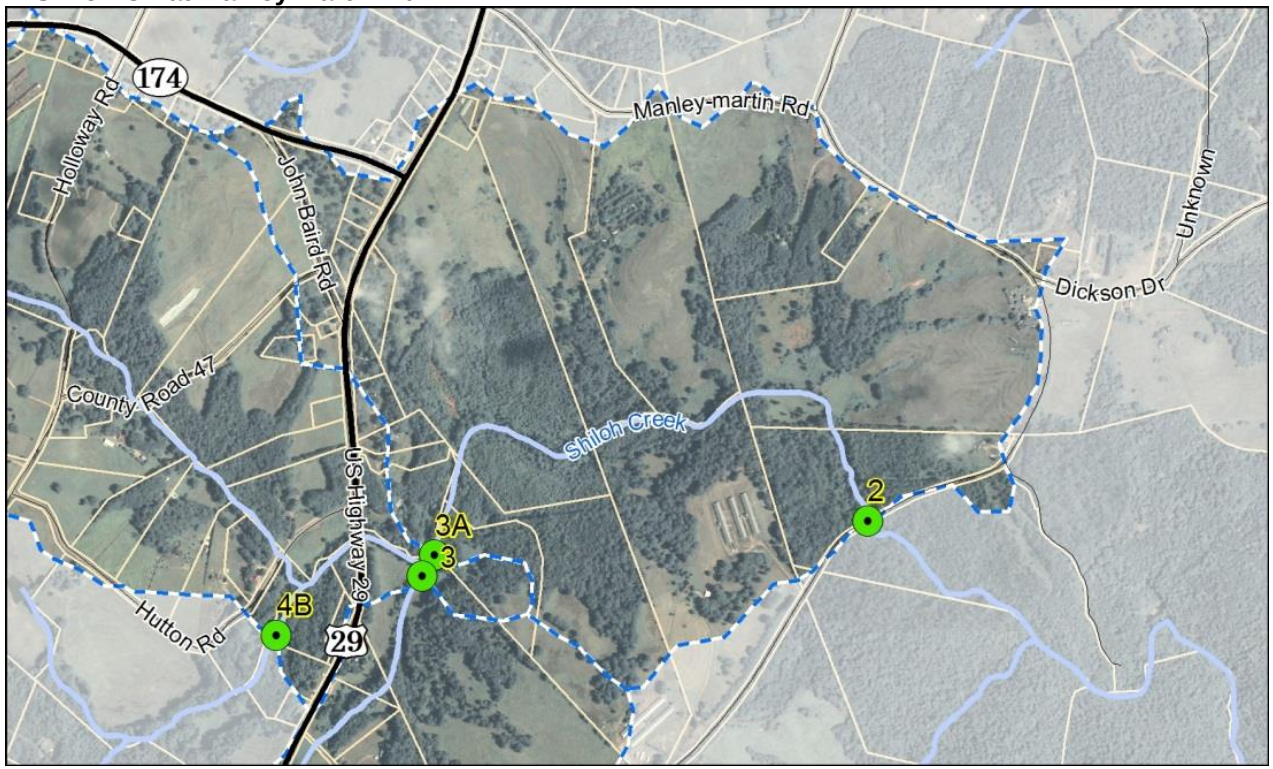
Table 5: Revised Potential Source Ranking for the Broad River

POTENTIAL SOURCES	ESTIMATED EXTENT OF CONTRIBUTION		ESTIMATED PORTION OF CONTRIBUTION		*IMPACT RATING (A X B)*
	Comments	***Rating (A)***	**Comments**	***Rating (B)***	
Wildlife	Forestry/logging is not a primary land use in the watershed, but wildlife may populate other land areas	2	Unknown – bacterial source-tracking would be helpful	1	2
Animal Production	Animal production is thought to be the predominant use of land	3	Animal production in close proximity to tributaries but not TMDL segment	3	9
Failing Septic Systems	Residential is 18% land use	1	Several residential parcels adjacent to TMDL segment; potential exists for failing septic	3	3
Illegal Dumping		UNK		UNK	UNK

To better understand the exact area drained by each sampling point (and, thereby, the specific physical properties from which runoff could reach the monitoring sites), NEGRC staff developed a model to divide the larger watershed into “micro-watersheds” (MW). These MWs are defined not only by the land upstream of the sampling points, but also by topographic features that dictate where water drains. Just as larger watersheds are defined by topography, likewise, these MWs are delineated based on high elevations (ridge lines, for example), and they provide precision far greater than simply examining land upstream from the monitoring locations.

Through targeted monitoring associated with this WMP, stakeholders and planners identified several “hot spots” that likely contribute to fecal contamination within the watershed. Those points of significant contamination, with detailed descriptions of the land area contained in their MWs, are as follows:

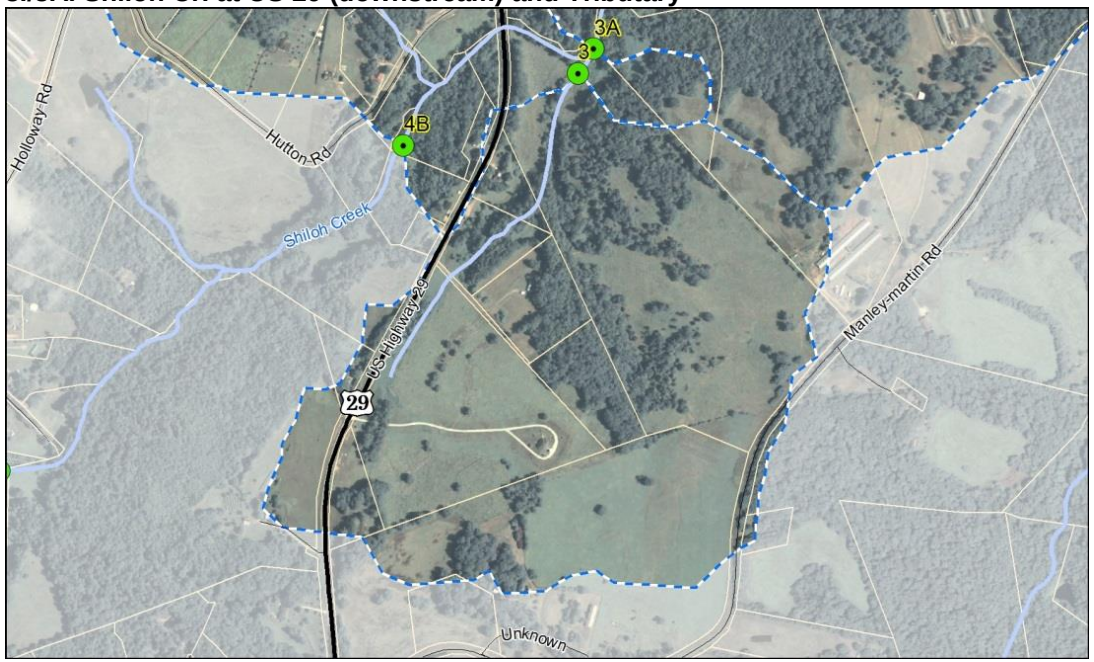
2. Shiloh Cr. at Manley Martin Rd.

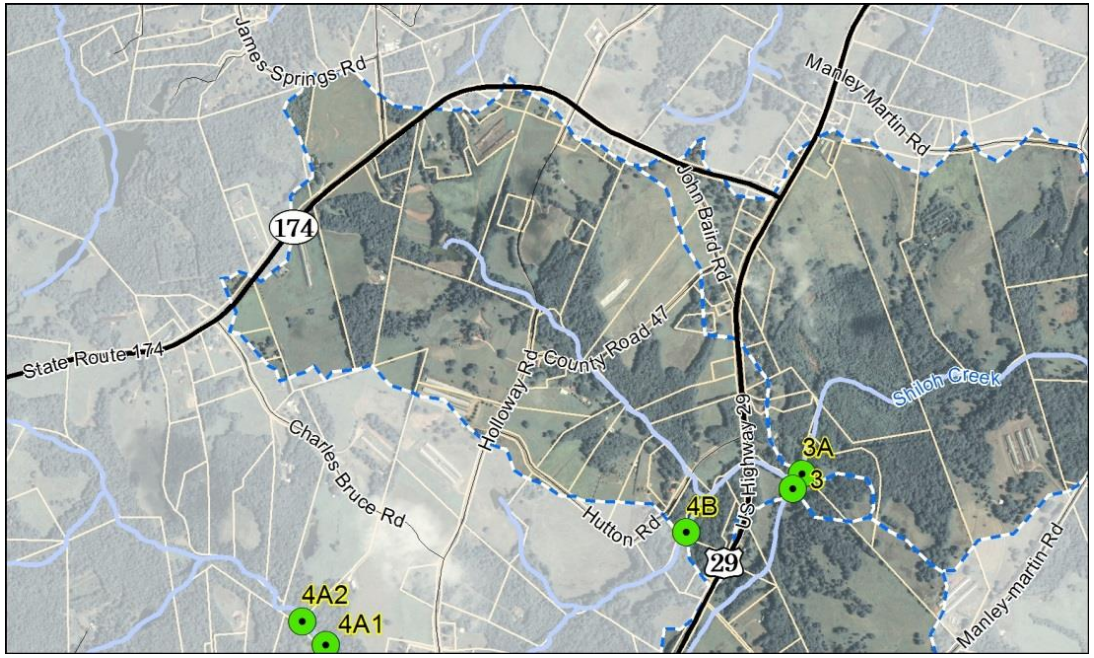


Chicken houses exist within the MW, but their immediate operation should not be problematic, as stakeholders indicate that appropriate BMPs are in use. Rather, the spreading of chicken litter on fields would be potential cause for concern if stack houses are not used to reduce coliforms prior to spreading. The terrain slopes relatively steeply from the chicken houses to the creek, and substantial litter has been documented here by sampling volunteers.

Cows were documented in the creek by sampling volunteers, across the stream from the chicken houses. Parcels 062 082, 062 083, and 062 079 are of concern.

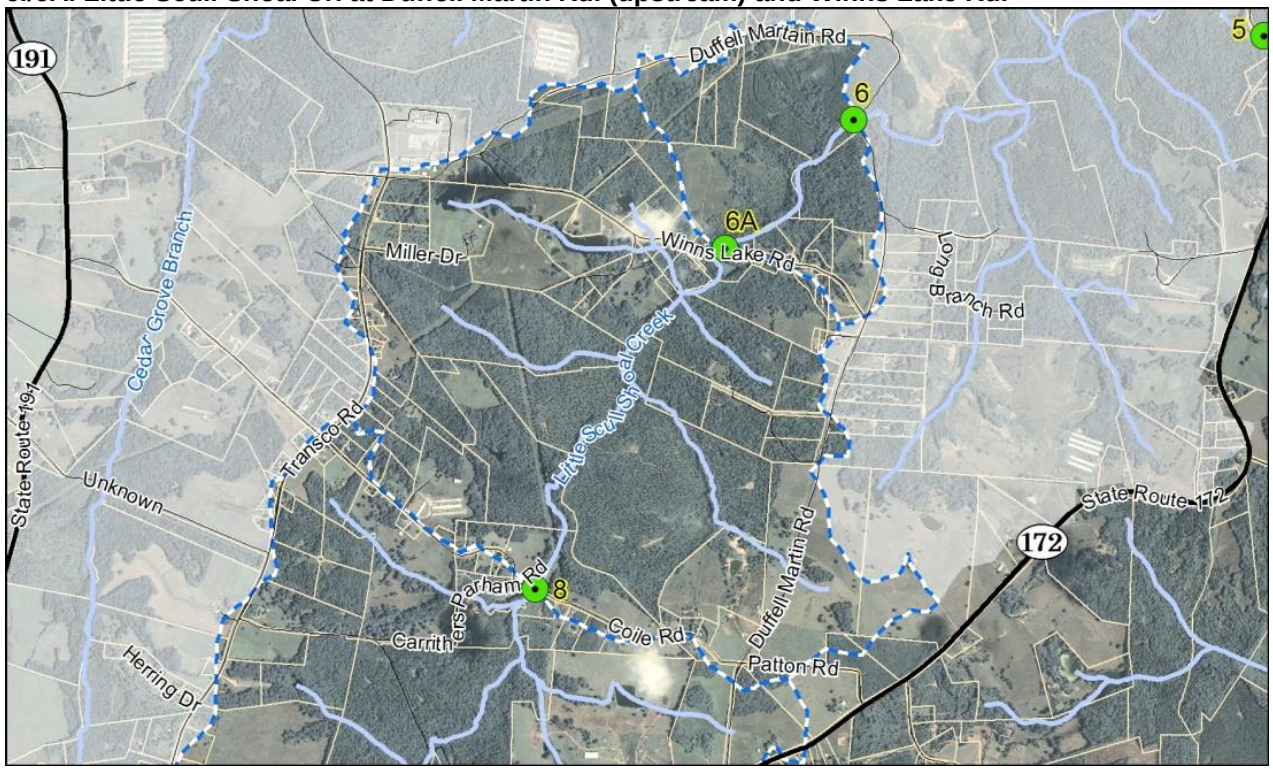
3./3A. Shiloh Cr. at US 29 (downstream) and Tributary





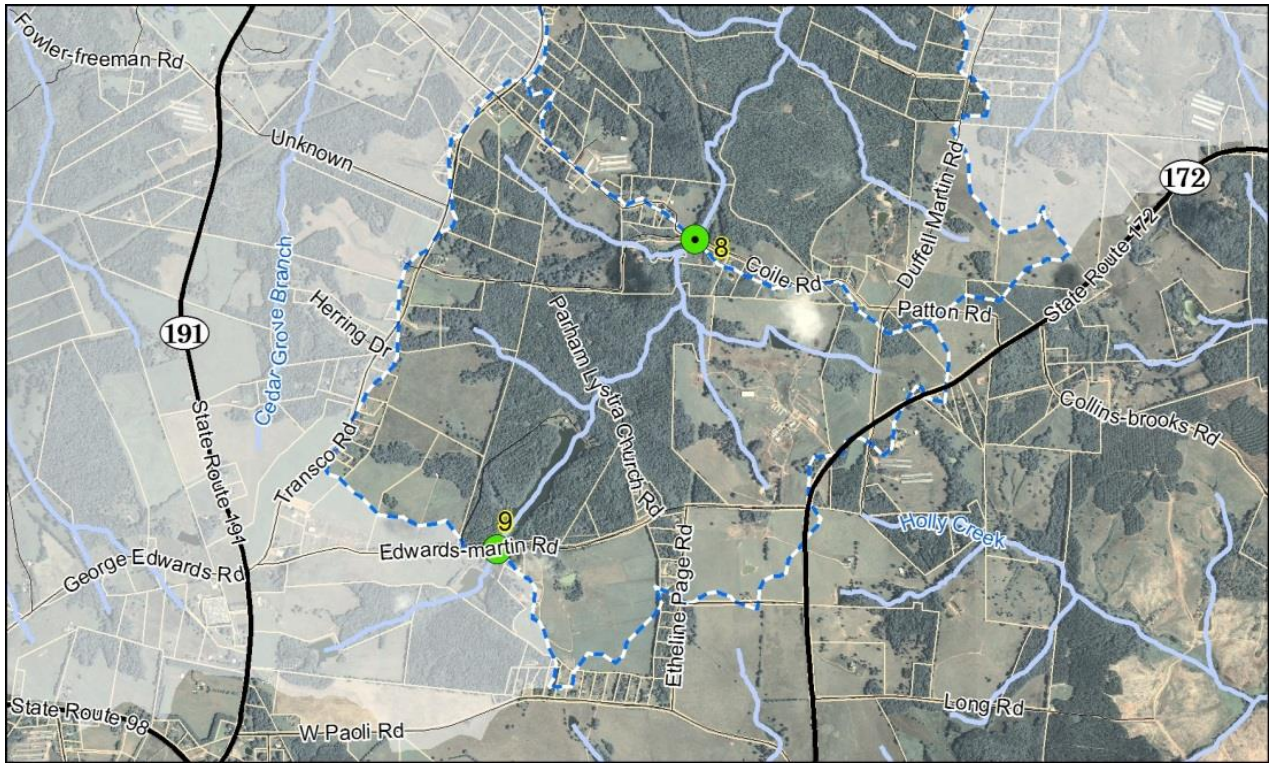
Cows in these MWs have creek access, and chicken litter was also observed within the areas, although it is unknown whether the litter was/is stacked for sufficient time (extension agent recommends eight days or more) prior to spreading.

6./6A. Little Scull Shoal Cr. at Duffell Martin Rd. (upstream) and Winns Lake Rd.



Winns Lake was a pay-to-catch lake until approximately 10 years ago; the smaller, colored ponds observed on the aerials could be/have been hatcheries. A significant amount of this MW lies in pasture, and many houses on septic systems are also present.

8. Little Scull Shoal Cr. at Coile Rd.



Monitors observed hundreds of cows in and around a pond on parcel 081 040 during the December 2013 sampling event. Septic also may be worth examining here – many homes are situated along the road.

V. Identification of Applicable Existing Management Measures

The following measures are among those that were identified in the TMDLIP:

Table 6: TMDLIP Existing Management Measures

BEST MANAGEMENT PRACTICE	RESPONSIBILITY	DESCRIPTION	SOURCES OF FUNDING & RESOURCES	STATUS CODE	TARGET DATE
Federal Clean Water Act, Section 305(b) and 303(d)	USEPA, Georgia DNR/EPD, Local/County Government	The congressional objective of the CWA "is to restore and maintain the chemical, physical, and biological integrity of the Nation's waters." Section 305 (the *National Water Quality Inventory*) requires states to report progress in restoring impaired waters to EPA on a biennial basis. Section 303(d) requires states to identify 'impaired' waters, submit a list to EPA every two years, and develop TMDLs for these waters.	Federal, State	A	In place, On-going
Georgia Water Quality Control Act (OCGA 12-5-20)	Georgia Rules and Regulations for Water Quality Control, Chapter 391-3-6	Law prohibiting discharge of excessive pollutants (sediments, nutrients, pesticides, animal wastes, etc.) into waters of the State in amounts harmful to public health, safety, or welfare, or to animals, birds, or aquatic life or the physical destruction of stream habitats. Law authorizing Georgia EPD to control water pollution, eliminate phosphate detergents and regulate sludge disposal; to require permits for agricultural ground and surface water withdrawals; to prohibit siltation of state waters by land disturbing activities and require undisturbed buffers along state waters; to require land-use plans that include controls to protect drinking water supply sources and wetlands; to require river basin management plans on a rotation schedule for all major river basins.	Federal, State, Local/County Governments	A	In place, on-going
Georgia Planning Act, Part 5	NEGRDC, Madison County	Coordinated Planning Program, managed by Georgia DCA requires local governments to identify Developments of Regional Impact (DRI) and develop plans to protect and manage Regional Impact Resources (RIR).	Local/County Governments Impact Fees	A	In place, on-going
Post-Development Stormwater Ordinance	Madison County	Stormwater ordinance complies with NPDES Phase II, which wouldn't have been required until after 2010. Requires post development storm water BMPs for land disturbing activities that create 5,000 square feet of impervious surface or that involve land development of 1 acre or more.	Madison County	A	2006
Development Standards Program	Madison County	Creates point system for approval of development. Must have 200 points for approval. Different development practices worth different number of points. Some practices involve increasing or maintaining tree cover and greenspace.		A	
Rivers Alive	Keep Madison Beautiful	Annual river cleanup. Keep Madison Beautiful leads volunteer effort on Broad River in Elbert, Madison and Oglethorpe Counties.		A	Ongoing
Illegal Dumping Programs	Madison County	Develop ordinance forbidding illegal dumping of waste, place no dumping signs, and allow for citizen reporting of illegal dumping.		A	In place, on-going
Chapter 40-13-8 Animal Manure Handlers Rules of Georgia Department of Agriculture Animal Industry Division	Georgia Department of Agriculture	This requires that persons engaged in removing animal manure from livestock/poultry production areas, transporting animal manure on public roadways, or depositing animal manure to a premise other than its point of origin obtain a permit and follow rules to control animal disease, and outlines regulations for transportation, equipment and storage.	State	R	In place, on-going

Table 6: TMDLIP Existing Management Measures					
BEST MANAGEMENT PRACTICE	**RESPONSIBILITY**	**DESCRIPTION**	**SOURCES OF FUNDING & RESOURCES**	**STATUS CODE**	**TARGET DATE**
Conservation Reserve Program (CRP)	Natural Resources Conservation Services / USDA Farm Services Agency	Provides technical assistance, rental payments and cost share funding to address specific natural resource concerns including: protection [of] ground and surface waters, soil erosion and wildlife habitat. Eligible practices include tree planting, grassed waterways, wildlife habitat buffers, and shallow water area for wildlife and filter strips.	Federal Annual rental payment for land taken out of production and 50% cost share for practice installation.	A	In place, on-going

Status Codes: *(A) installed and active; (R) required by law, regulation, or permit conditions*

VI. Recommendations for Additional Management Measures

Stakeholders developed the following goals for the project and the watershed:

1. Pinpoint sources of contamination and improve water quality
2. Delist the Broad River as an impaired stream with the State of Georgia
3. Build community among stream advocates, landowners, and government officials

In addition to the existing management practices listed previously, further potential BMPs were evaluated for consideration as final recommended BMPs. The potential management practices apply to agricultural, forested, and residential land, and were evaluated against the goals for the project. Based on the micro-watersheds previously described, the revised Potential Source Ranking, and the project's goals, planners examined the nature of the land drained by each problematic sampling point. This allows for an analysis of property based on the following characteristics of each MW identified as problematic:

- Presence of cows and cow pasture
- Ability of cows, if present, to access streams or ponds
- Presence of chicken houses
- Presence of ponds (or similar)
- Presence of residential homes, particularly with regard to septic systems
- Presence of forested land
- Topography

The highest-rated management practices are presented further in the document as final recommended best management practices (BMPs). Sources of information include:

Effectiveness of Best Management Practices for Bacteria Removal, Emmons & Oliver Resources (http://www.pca.state.mn.us/index.php/view-document.html?gid=16328); National Management Measures to Control Nonpoint Source Pollution from Agriculture, US EPA (www.epa.gov/owow/nps/agmm/index.html); Agricultural Best Management Practices for Protecting Water Quality in Georgia, Georgia Soil & Water Conservation Commission (http://www.gaepd.org/Files_PDF/techguide/wpb/Agriculture_Best_Management_Practices_March_2007.pdf); The University of Georgia Cooperative Extension Service

Table 7: Potential Management Practices				
Management Practice	**Definition**	**Estimated Effectiveness***	**Estimated Load Reductions***	**Land Use**
Wetland treatment systems	Treating wastewater and storm water inputs	79%	Low (costly, unlikely to be implemented)	Agriculture/Forested
Limiting livestock access to riparian areas	Providing alternative water and shade for livestock	High	High	Agriculture
Apply litter based on nutrient needs of crops	Reduces the over application of litter	Low	Low	Agriculture
Detention and Retention Ponds	Allows for sediment containing bacteria to settle out of runoff	Wet 15-20% Dry 90%	Medium	Agriculture
Bio-filtration/Filtration	Filters runoff trough a medium of sand, gravel, and/or compost	92%	Low (costly, unlikely to be implemented on a large scale)	Agriculture/Forested
Vegetated buffers/Filter strips/Swales	Filters out sediment containing bacteria	Dependent on size and length	High	Agriculture
Manure management	Methods to better transport, store, use, and treat	Unknown	Medium	Agriculture
Pollution prevention and source controls	Pet waste control, septic maintenance, street sweeping, wildlife management	Medium	Low	Agriculture/Forested /Urban
Stormwater runoff controls for new development, existing development, and redevelopment (Compliance with local ordinances and state regulations)	Applying stormwater quality standards; enact Phase I and II NPDES Stormwater Permit requirements for pollution prevention	>75%	Low (little impervious surface in watershed)	Urban
Prevent and/or manage spills, illicit discharges, and wastewater system problems	Enact Phase I and II NPDES Stormwater Permit requirements for illicit discharge detection and elimination	25-50%	Medium	Urban
Monitoring malfunctioning septic tanks	Monitor for failures and promote cleanout procedures	Clean-out 10-25% Failure detection 50-75%	Medium	Urban
Agricultural water conservation	Reduce runoff, erosion, etc., and increase stream dilution	Unknown	Medium	Agriculture
Stack houses for poultry litter	Encourage stacking or composting of litter prior to land application to reduce risk for bacteria loading	High	Medium	Agriculture
Nutrient management and erosion control	Nutrient application and soil management	High	Low	Agriculture
Wildlife management	Address wildlife overpopulation and concentration	Medium	Medium	Forest

Table 7: Potential Management Practices				
Management Practice	**Definition**	**Estimated Effectiveness***	**Estimated Load Reductions***	**Land Use**
Educational programs and materials	Education for general public	Medium	Medium	Urban/Agriculture/ Forested
Stream bank restoration	Diffuse runoff and erosion as well as provide buffer for streams	Low	Low	Forested
Animal mortality facilities	Disposal of animal carcasses	Unknown	Low	Agriculture
Stream crossings	Concentrates animal/livestock crossing over structure	High	Medium	Agriculture
Riparian herbaceous cover/Forest buffer	Reduce runoff, erosion, etc.	Medium	Medium	Agriculture /Forested
Prescribed grazing	Manage grazing of livestock across fields to reduce erosion	Medium	Medium	Agriculture

**Estimated Effectiveness refers to the MP's ability to reduce contamination in concept; Estimated Load Reductions apply that effectiveness to this watershed (in particular, to the selected MWs).*

AGRICULTURAL BMPS

Wetland Treatment Systems
Wetland constructed for the sole purpose of treating wastewater and stormwater inputs. The cons associated with this MP are that there has been evidence of increased levels of bacteria from the outfall of the wetland compared to what enters the wetland. Constructed wetlands are successful at allowing the sediment and bacteria to settle. However, the presence of waterfowl and other wildlife may cause increases in bacteria leaving the system. On average, as taken from several sources, the removal effectiveness was 79%.

Limiting Livestock Access to Riparian Areas and Streams
Best implemented when producers have alternative water sources and shade for their livestock

Apply Litter Based on Nutrient Needs of the Crops with the Nutrient Content of the Litter
This helps prevent over-application of litter. Also, the time of litter application should be managed so as to not precede a rain event.

Detention and Retention Ponds
Ponds constructed to allow for the settling of particles captured by runoff. This type of MP would include sedimentation ponds. Removal effectiveness in wet retention ponds, on average from varying sources, is about 15-20%. Removal effectiveness in dry retention ponds are, on average, about 90%. Dry retention ponds differ from wet ponds as they drain completely dry and only store water temporarily. In some cases, bacteria level increases in the outflow compared to the input may be associated with sediment washed out by storm events.

Bio-Filtration/Filtration
This management practice allows stormwater to flow through a medium of sand, compost, or soil, or a combination thereof, to filter out sediment. Removal effectiveness of bacteria is, on average, around 92%.

Vegetated Buffers/Filter Strips/Swales
Strips of vegetation next to an area of runoff. The runoff flows over the buffer or filter strip to allow sediment to be captured and allow water to be filtered into the soil. The effectiveness in removing bacteria is dependent on the size and length of the strip.

Manure Management
Methods to better store, use, and treat manure to limit the potential for bacteria to be transported into water.

Pollution Prevention and Source Controls
Limit the introduction of bacteria into locations in the landscape that could possibly allow for the transport into rivers or riparian zones. Pet waste control, septic maintenance, street sweeping, and wildlife management are examples.

Agricultural Water Conservation
Limit the use of water for irrigation of crops and fields. Reducing water use can reduce the occurrence of runoff from contaminated fields and allow for water to infiltrate the soil.

Stack Houses for Poultry Litter
This will be a long-term objective, promoting such structures and supporting efforts to make them affordable/available to area farmers. Poultry farming is prevalent locally, and the litter byproduct can prove difficult to process or dispose, either on- or off-site. Stack houses provide an effective means for storing and managing chicken litter and might minimize the volume of litter applied on local fields. Estimated effectiveness is medium with a percent load reduction of 10%. Poultry growers should consider stacking broiler litter for more than eight days to eliminate fecal coliforms in runoff from land-spread litter.

Nutrient Management and Erosion Control
This is the catch-all category for on-site property improvements and best management practices designed to mitigate the ability of cultivated soil amendments to wash off fields and find their way into the stream. This can include setbacks, nutrient management, swales and landscaping or other measures. All such measures should be done according to the latest standards advised by NRCS, and should be pursued in coordination with an overall improvement plan for the subject property.

Animal Mortality Facilities
Permanent structures used to dispose of carcasses, including burial pits, mortality composting facility, incinerators, and freezers. MP can improve soil and water quality.

Stream Crossings
Designed to protect water quality and erosion by concentrating animal and livestock crossings over stable access points or structures. This management practice can be paired with other practices including designated animal trails to further reduce erosion of contaminated soil and sediment.

Riparian Herbaceous Cover/Forest Buffer
Use shrubbery or grass-like vegetation to act as a filter for sediment transport into waterways.

Prescribed Grazing
Maintain vegetative cover and soil management by limiting grazing by animals and livestock. Reduces sediment runoff by allowing vegetation to continue to grow and prevent fields from being overgrazed.

URBAN BMPS

Stormwater Runoff from New Development, Existing Development, and Redevelopment
Enact required post-construction stormwater quality management practices and amend/create local land development codes and ordinances for the implementation of stormwater quality management practices for new and redeveloped areas (new development and redevelopment). Enact Phase I and II NPDES Stormwater Permit requirements for pollution prevention and good housekeeping in *permitted developed areas*, and voluntarily enact such measures in *unpermitted developed areas* (existing development)**.** Overall effectiveness in reducing contaminants in stormwater runoff should exceed >75% in reduction. Voluntary *housekeeping* activities should achieve about 10% reduction in contaminants in runoff.

Prevent and/or Manage Spills, Illicit Discharges, and Wastewater System Problems
Enact Phase I and II NPDES Stormwater Permit requirements for illicit discharge detection and elimination in *permitted developed areas*. Voluntarily enact such measures in *unpermitted developed areas*. Apply specific operation and maintenance BMPs listed in the Metro North Georgia Water Planning District Watershed Management Plan to existing development. Application of required illicit discharge detection and elimination activities should achieve a 25-50% reduction in all major contaminant loads from spills, illicit discharges, and wastewater leaks in areas where applied.

Monitoring Malfunctioning Septic Tanks
Enact septic tank cleanout program ordinances and septic tank failure detection and correction programs or ordinances. Required cleanout programs should achieve 10-25% reductions in pathogens and nutrient loads. Failure detection and correction programs should achieve a 50-75% reduction.

Educational Programs and Materials
Communities employ various methods to engage area residents, employers, and developers on the rules and efforts behind maintaining local water quality. A specialized approach for the watershed could aid in this effort by providing targeted information to critical stakeholders, building a stronger sense of vested interest among property owners and business owners, and increasing awareness of and support for BMPs and mitigation measures. This could include promotional materials illustrating the health of the watershed and special guidance about WMP-related activities and issues.

FORESTRY BMPS

Wildlife Management
This is the general term for measures designed to address animal overpopulation or the concentration and infiltration of specific animals into streams and lakes. This can include the forced removal of animals, the introduction of measures to deter animals, or adjustments in hunting policies.

Stream Bank Restoration
This is a landscaping and engineering effort to restore the integrity of declining stream banks. Shorelines prone to washouts and erosion issues often need structural repair, and these singular engineering projects can repair the bank's ability to treat and slow stormwater runoff, as well as aiding shade conditions and litter control.

Potential BMPs were evaluated against the following criteria to determine their likely utility with respect to lowering bacterial contamination within the watershed, allowing for an analysis of property based on the identified problematic MWs:

- Location, especially with respect to proximity to problematic MWs and streams, physical factors such as topography, and use of land (e.g., presence of cows and pasture, chicken houses, litter, ponds, septic tanks, forested land, etc.)
- Estimated effectiveness and load reduction
- Community acceptance

Final recommended BMPs are:

Table 8: Final Recommended Best Management Practices Ranking

Management Practice	**Location, Physical Factors, and Use of Land (Rank 1-5)**	**Estimated Effectiveness and Load Reduction (Rank 1-5)**	**Community Acceptance (Rank 1-5)**	**Average and Comments**
Educational programs and materials	5	4	5	4.7 – Producers and homeowners may simply not be aware of the issues
Limiting livestock access to riparian areas	5	5	3	4.3 – High-impact BMP; producers used to allowing cattle unfettered access to streams might be resistant
Vegetated buffers/Filter strips/Swales	4	5	4	4.3 – Effective with any type of agriculture, including cattle production and spreading of chicken litter
Stack houses for poultry litter	3	4	4	3.7 – Extent of use of unstacked litter is unknown
Monitoring malfunctioning septic tanks	2	4	4	3.3 – Not thought to be as widespread an issue as agriculture, but highest-impact “urban” BMP
Wildlife management	2	3	5	3.3 – Wildlife not thought to be primary contributor to contamination; geese and feral hogs are the most likely concerns
Stream crossings	3	4	3	3.3 – Could be cost-prohibitive in some situations, but highly effective

VII. Partner Organizations and Advisory Groups

Table 9: Partnership Advisory Council			
Name	**Organization**	**Name**	**Organization**
Brenda Bailey	Broad River Watershed Association	Rick Kelly	Broad River Watershed Association
Michael Moody	Broad River Watershed Association	Victor Johnson	Broad River Watershed Association
Tom Krobot	Broad River Watershed Association	Carly Robinson	Camp Kiwanis
Ellen Forbus	Broad River Watershed Association	Adam Speir	Madison County Extension
Ken Forbus	Broad River Watershed Association	Linda Fortson	Madison County Planning & Zoning
Jean Smith	Broad River Watershed Association	Jack Huff	Madison County Code Enforcement
Sam Linhart	Broad River Watershed Association	Johnny Bridges	Madison County Emergency Management Agency
Pat Kelly	Broad River Watershed Association		

These partners will be essential to developing a successful implementation program for this project. For example, as part of an application process for funding desired improvements, stakeholders will be asked to outline potential contributions they can make to the undertaking. These would include professional and/or technical assistance, cash or in-kind services, supplies and materials, volunteer labor, and other resources. The local government(s), the Northeast Georgia Regional Commission, the Georgia EPD, the Broad River Watershed Association, the University of Georgia, local schools, and the Oconee River RC&D should be relied upon for assistance, as should individual landowners whose property could directly affect water quality. Since a specific scope of improvements has not been developed, a budget is currently unavailable.

VIII. Milestones & Implementation Schedule

Table 10: Milestones & Implementation Schedule		
Activity	**Target Date**	**Responsible Party**
Continue monitoring to refine understanding of contamination sources	Ongoing	BRWA, GAEPD, NEGRC (contingent upon funding availability)
Evaluate potential for applying for 319(h) funds to implement BMPs and continue watershed monitoring	Fall 2014	Madison County, BRWA, Oconee River RC&D, NEGRC, GAEPD, Stakeholders
Apply for 319(h) funding, if applicable. If funding is applied for and received, city/county government, BRWA, Oconee River RC&D, NEGRC, GAEPD, and/or stakeholders will need to determine other steps and milestones necessary to successfully fulfill the grant's goals and scope. *See below for specific timeline information on implementation schedule for Final Recommended BMPs.*	Next cycle deadline (2013 deadline was 10/31)	Madison County, BRWA, Oconee River RC&D, NEGRC, GAEPD, Stakeholders

Table 10: Milestones & Implementation Schedule		
Activity	**Target Date**	**Responsible Party**
Open communication with health department to identify potential for a review of potentially problematic septic systems	2014-2015	Madison County, BRWA, GAEPD, Stakeholders
Work with GAEPD to remove (if applicable) the Broad R from the contaminated waters list while focusing attention on problematic tributaries	Long-range	Madison County, BRWA, GAEPD, Stakeholders

Implementing the Final Recommended Best Management Practices found in section VI of this document is a critical component of improving the watershed. The following table outlines an implementation program specific to the BMPs:

Table 11: Final Recommended Best Management Practices Implementation Program			
Management Practice	**Implementation Timeline**	**Responsible Implementing Entity(ies)**	**Potential Funding Source** *(see following for more information)*
Educational programs and materials	Ongoing (begin immediately)	BRWA, Local government, NEGRC, EPD, other organizations	319 Program, NIWQP, EE Grants
Limiting livestock access to riparian areas	Mid-Term (2-5 years)	Producers	319 Program, NIWQP, AMA, EQIP
Vegetated buffers/Filter strips/Swales	Mid-Term (2-5 years)	Producers and other landowners	319 Program, NIWQP, AMA, EQIP
Stack houses for poultry litter	Long-Term (5-plus years)	Producers	319 Program, NIWQP, EQIP
Monitoring malfunctioning septic tanks	Short-Term (<2 years)	Homeowners, business owners, and health department	319 Program, NIWQP, EQIP
Wildlife management	Mid-Term (2-5 years)	Landowners	319 Program
Stream crossings	Long-Term (5-plus years)	Producers	319 Program, NIWQP, EQIP

FUNDING SOURCES

Agricultural Management Assistance (AMA)
Provides cost-share assistance to agricultural producers to voluntarily address issues such as water management, water quality, and erosion control by incorporating conservation into farming operations.

Environmental Education Grants (EE Grants)
USEPA seeks grant proposals from eligible applicants to support environmental education projects that promote environmental stewardship and help develop knowledgeable and responsible students, teachers, and citizens.

Environmental Quality Incentives Program (EQIP)
The USDA Natural Resources Conservation Service's EQIP provides financial and technical assistance to agricultural producers in order to address natural resource concerns and deliver environmental benefits such as improved water and air quality, conserved ground and surface water, reduced soil erosion and sedimentation, and improved or created wildlife habitat.

National Integrated Water Quality Program (NIWQP)
NIWQP provides funding for research, education, and extension projects aimed at improving water quality in agricultural and rural watersheds.

Nonpoint Source Implementation Grants (319 Program)
Through its 319 program, USEPA provides formula grants to implement nonpoint source projects to protect source water areas and the general quality of water resources in a watershed, including BMP design, implementation, and installation, as well as education.

IX. Public Involvement, Education, and Outreach

A Partnership Advisory Council was formed to solicit input from a variety of stakeholders, including government elected officials and staff, property owners, academic researchers, and others. Continued engagement of stakeholders and the general public is recommended to implement the plan. This should include an education/outreach component that deals with water quality, the relationship between nonpoint source pollution and stormwater runoff, and other key components.

Additionally, the following programs are recommended for consideration by stakeholders as potential education and outreach tools:

- Green Schools Initiative
- Georgia Adopt-a-Stream continued monitoring
- Rivers Alive and other stream clean-up events
- Storm drain marking
- Septic system awareness and maintenance
- Water conservation
- Festivals and other similar events promoting water quality education across all ages
- Paddling and walking events on and along the river to build awareness and build connections within the watershed

X. Recommendations for Monitoring and Criteria for Measuring Success

Since "hot spots" of increased contaminant load (within the previously documented problematic micro-watersheds) will exhibit unique causes (e.g., while septic systems may be to blame at one location that has exhibited high readings, livestock may be the prime contributor at another), it is important to monitor stream conditions before, during, and after initiation of corrective measures, and to install location-appropriate BMPs. Sampling points should be identified to isolate particular sources and locales from one another; these points might differ from the locations monitored during the development of this WIP.

If sufficient funding is available, this would be an excellent opportunity to introduce the use of bacterial source tracking. Because BST provides an understanding of the type of pollutant source (human, livestock, wildlife), it could become an integral part of both appropriate BMP installation and post-BMP monitoring: as a BMP that targets a particular source type is implemented, stakeholders could use data to confirm or deny the efficacy of the new measures.

Monthly monitoring using the Georgia Adopt-a-Stream protocols has been a successful, manageable, and affordable resource for this project; it should be continued unless other more accurate, frequent, or otherwise desirable methods are identified. Aside from data that characterize stream conditions, it would be advisable to monitor the utility and effectiveness of less quantitative measures, such as education and outreach.

Thus, the criteria that should be used to measure success in this project should include:

Long-Term Water Quality Monitoring – A complete sampling strategy will include both general watershed testing and site-specific monitoring that gauges the effectiveness of BMP installations.

- Measure: stakeholders/monitors will develop a QA/QC Monitoring Plan that identifies the number/location of sites, sampling protocols, and data reporting procedures

BMP Implementation (Physical) – Develop BMPs relating to physical property improvements and/or land use practices that reduce the impact of pollutants on water quality. While implementers should encourage application of BMPs throughout the watershed, funding assistance should target "hot spots" first, and then be directed elsewhere.

- Measure: approach landowners/managers within each identified problematic micro-watershed, with the intended result of implementing relevant BMPs on the associated property
  - In predominantly agricultural areas, the measure for success is at least one landowner/manager per MW
  - In predominantly non-agricultural areas, the measure for success is at least three landowners/managers per MW

BMP Implementation (Programmatic) – Ensure that the "Educational programs and materials" BMP developed in this WMP is applied throughout (and, if applicable, beyond) the watershed.

- Measure: deliver at least one presentation per quarter on water quality and recommended BMPs to interested groups
- Measure: distribute promotional/educational materials at no fewer than three events yearly
- Measure: send at least 100 mail-outs yearly, targeted specifically to the problematic MWs first, and then to a wider area

The steps presented in this plan should be refined during the process of implementing management measures; they will need to be tailored to individual sites, landowner preferences, resource availability, and the willingness of decision makers to embrace them. A targeted reduction of approximately 10% of fecal coliform would be a reasonable expectation to associate with these improvements.

In summary, and according to the USEPA Guidelines for Watershed Planning (Appendix A), the milestones described in Chapter VIII of this document should be used to outline a schedule and timeline for improvements; any additional criteria that relate directly to the preferred alternatives should be established, if applicable, to determine whether substantial progress is being made; and stakeholders should continue monitoring to evaluate the effectiveness of implementation measures.

Appendix A

USEPA Guidelines for Watershed Planning (9 Key Elements)

Web Access to Section 319 (h) Application Guidelines:
http://www.gaepd.org/Documents/epdforms_wpb.html#nps

GA EPD recommends that the Watershed Management Plan include the following elements to comply with USEPA Guidelines:

1) An identification of the sources or groups of similar sources contributing to nonpoint source pollution to be controlled to implement load allocations or achieve water quality standards. Sources should be identified at the subcategory level with estimates of the extent to which they are present in the watershed (e.g., X numbers of cattle feedlots needing upgrading, Y acres of row crops needing improved sediment control, or Z linear miles of eroded stream bank needing remediation);

2) An estimate of the load reductions expected for the management measures described under paragraph (3) below;

3) A description of the NPS management measures that will need to be implemented to achieve the load reductions established in the TMDL or to achieve water quality standards;

4) An estimate of the sources of funding needed, and/or authorities that will be relied upon, to implement the plan;

5) An information/education component that will be used to enhance public understanding of and participation in implementing the plan;

6) A schedule for implementing the management measures that is reasonably expeditious;

7) A description of interim, measurable milestones (e.g., amount of load reductions, improvement in biological or habitat parameters) for determining whether management measures or other control actions are being implemented;

8) A set of criteria that can be used to determine whether substantial progress is being made towards attaining water quality standards and, if not, the criteria for determining whether the plan needs to be revised; and;

9) A monitoring component to evaluate the effectiveness of the implementation efforts, measured against the criteria established under item (8).

Appendix B

Field Notes and Pictures

This section of the appendix includes reports on the Tributary Stream Walks conducted in 2009 and 2013.

These documents follow.

APPENDIX

Broad River (SR 281 to Scull Shoal Creek near Danielsville)
Tributary Stream Walk
February 10, 2009 and *March 2013 (updates italicized)*

Broad River Watershed Association (BRWA)
Georgia DNR Environmental Protection Division (Georgia EPD)
- Watershed Protection Branch, TMDL Implementation Program
Georgia DNR Wildlife Resources Division - Law Enforcement Section
Madison County - Code Enforcement
Northeast Georgia Regional Commission (NEGRC)

I. Targeted Watershed Monitoring -- Data Summary

The Broad River Watershed Association collected and tested in-stream samples for E. coli bacteria during four monitoring periods at six targeted sites in an impaired watershed of the Broad River (SR 281 to Scull Shoal Creek near Danielsville).

E. coli data from the first two targeted watershed monitoring periods (September and November 2008) indicated high bacteria loads at Sampling Site #6 (Shiloh Creek at Manley Martin Road) upstream of the Georgia EPD listing station (Sampling Site #3 at SR281). Downstream Sampling Site #2 (Scull Shoal Creek at David's Home Church Road) presented high bacteria loads during the September 2008 monitoring period.

During the January 2009 targeted watershed monitoring period, data from all six sampling sites showed counts within the recommended healthy level. In May 2009, Sampling Site #6 again presented high E. coli levels, this time in the extreme, while data from the other five sampling sites were within the recommended healthy level.

The USEPA recommends a single grab sample of 235 counts/100ml to be a healthy level of E. coli in a water body, based on an illness rate of eight people per 1000 after exposure.

Data were collected along Scull Shoal Creek, Shiloh Creek, and the Broad River from May through August 2011 as part of the truncated Watershed Improvement Plan process, which eventually was reinitiated as a new Watershed Management Plan (WMP) process. The 2011 data showed little contamination on the Broad River, but higher numbers on the tributary creeks, especially Shiloh Creek.

2011 Sampling Data

Date	*Site 1*	*Site 2*	*Site 3*	*Site 4*	*Site 5*	*Site 6*	*Site 7*
5.3.11	100	467	300	233	167	400	300
6.2.11	100	500	433	661	0	200	533
7.12.11	0	2333	367	33	100	233	367
8.9.11	0	2333	3166	633	300	700	300

**orange cells indicate samples that exceeded 235 colony-forming units*

II. Stream Reconnaissance – Field Notes

Based on the above data, the BRWA and Georgia EPD convened on Tuesday, February 10, 2009, to conduct a stream reconnaissance along Scull Shoal Creek (Sampling Site #2) and Shiloh Creek (Sampling Site #6), walking upstream from the sampling sites at David's Church Road and Manley Martin Road respectively.

Scull Shoal Creek (Sampling Site #2)
- First house (#3414) 75 meters upstream: Structure located across floodplain (Figure 6)
  Entire flood plan mowed to the creek bank
- Second house ¼ mile upstream: Structure located approximately 200 feet from creek bank (Figure 3)
- Left fork tributary enters main stem approximately ½ mile upstream (Figure 5)

Shiloh Creek (Sampling Site #6)

- Evidence of bulldozer grading up to creek bank (Figure 11)
  Tracks disturbing channel from small spring or seep under rock (Figure 10)
- Approximately 200 meters upstream from road crossing pasture fence crosses creek (Figure 5)
- Obvious signs of cattle access to creek from pasture
  Pasture on both sides of creek with 20+ cows visible (Figure 8)
  Cow manure piles visible in creek (Figure 6)
  Three large bones (presumably cattle bones, since much larger than deer bones) near creek (Figure 7)
  - Calf creep feeder located near creek (Figure 8)

III. General Land Use Information

Scull Shoal Creek drainage area consists mostly of livestock and pasture. Any clear-cut timber areas will be or have been planted for pasture. Pastures are spread with chicken litter from poultry houses located throughout the watershed. Grazing livestock include cattle and horses.

Shiloh Creek receives local "clean-out" from poultry houses throughout drainage area. Livestock have access to creek from pastures.

During discussions that took place during the initial preparation of the Watershed Improvement Plan in 2011, it became apparent that, contrary to existing datasets, the predominant land use in this area of the watershed is agriculture. According to stakeholders, bovine and poultry operations are the primary forms of agriculture; this was confirmed upon field inspection.

IV. Recommendations

Georgia EPD recommends the five-mile impaired segment of Broad River from SR 281 to Scull Shoal Creek for an FY2010 Extended Revision (Watershed Improvement Project) to address loadings of bacteria from agricultural nonpoint sources.

The NEGRC is currently under contract with the Georgia EPD to complete a Watershed Management Plan for this watershed by March 2014. The WMP will present data, model scenarios to reduce contamination, and recommend potential BMP installations where appropriate.

Scull Shoal Creek at David's Home Church Road – 02/10/2009

Figure 1. Scull Shoal Creek: Roof turbine vent – Right bank looking U/S

Figure 2. Scull Shoal Creek: Ag (poultry?) drainage ditch – Left bank looking U/S

Figure 3. Scull Shoal Creek: Scum – Right bank looking U/S

Figure 4. Scull Shoal Creek: Right fork stem – Looking U/S

Figure 5. Scull Shoal Creek: Left fork tributary – Looking U/S

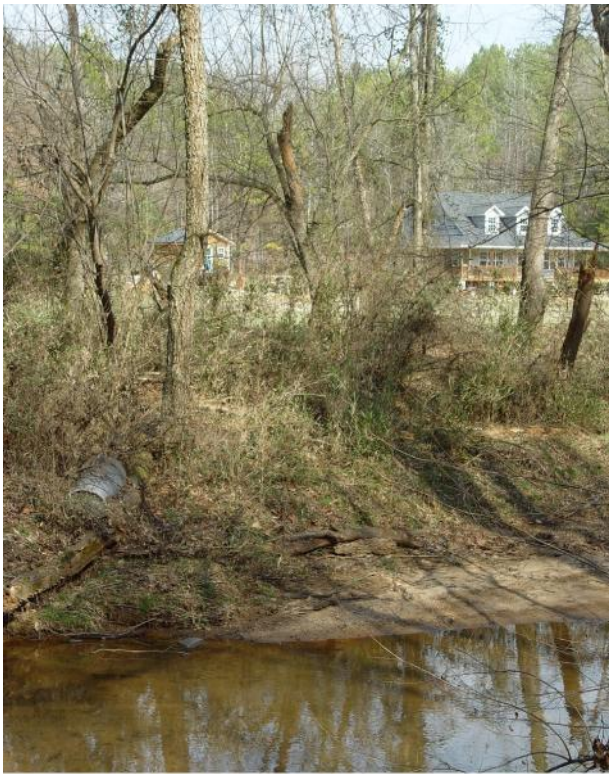


Figure 6. Scull Shoal Creek: Metal Trash Can – Right bank looking D/S

Figure 7. Scull Shoal Creek: Unpaved (dirt & gravel) county road crossing – Looking D/S

Figure 8. Scull Shoal Creek: Prop (vehicle?) imprint on road crossing – Looking D/S

Shiloh Creek at Manley Martin Road – 02/10/2009

Figure 1. Shiloh Creek: Cement block dump – Right bank looking U/S

Figure 2. Shiloh Creek: Scum – Left to right bank looking U/S

Figure 3. Shiloh Creek: Red algae – Right to left bank looking U/S

Figure 4. Shiloh Creek: Drainage ditch – Left bank looking U/S

Figure 5. Shiloh Creek: Cattle fence – Left to right bank looking U/S

Figure 6. Shiloh Creek: Cattle manure – Left bank looking U/S

Figure 7. Shiloh Creek: Cattle bone – Right bank looking U/S

Figure 8. Shiloh Creek: Cattle access to creek – Left bank looking U/S
(Manure circled in yellow) (Calf creep feeder not visible on curve of bank at red circle)

Figure 9. Shiloh Creek: Drainage ditch – Left bank looking D/S

Figure 10. Shiloh Creek: Spring or seep – Left bank looking D/S

Figure 11. Shiloh Creek: Front loader disturbed soil while clearing culvert of debris - Looking D/S

<u>Field Notes, 2013:</u> NEGRC and BRWA representatives conducted additional field work, with the purpose of establishing a new set of monitoring locations, in February 2013. The revised site list is based on previous sampling, field conditions, and right-of-access to the stream. Photos and site descriptions follow.

1. Broad R. at SR 281 – access at Broad River Outpost boat ramp (No photo available)

2. Shiloh Cr. at Manley Martin Rd. (downstream)

3. Shiloh Cr. at US 29 (upstream)

3A. Shiloh Cr. upstream of US 29

4. Shiloh Cr. at Holloway Rd. (upstream)

4A1. Shiloh Cr. upstream of Holloway Rd. (downstream site at farm)

4A2. Shiloh Cr. upstream of Holloway Rd. (upstream site at farm)

4B. Shiloh Cr. along Long Peeples Rd.

4C. Branch of Shiloh Cr. at Holloway Rd. (ditch draining wetland)

5. Scull Shoal Cr. at Davids Home Church Rd. (downstream)

6. Scull Shoal Cr. at Duffell Martin Rd. (upstream)

6A. Little Scull Shoal Cr. at Winns Lake Rd.

7. Scull Shoal Cr. at Transco Rd. (upstream)

7A. Scull Shoal Cr. upstream of Transco Rd. (No photo available)

7A Alt. Scull Shoal Cr. at SR 191 (upstream)

Appendix C

Education and Outreach Materials

This section includes handouts and mailers promoting reduction of bacterial contamination within the watershed, as well as slides for a presentation that can be delivered to public and stakeholder groups. The Northeast Georgia Regional Commission will provide original files upon request.

Watering station

Broad River Watershed Management Plan

A five-mile segment of the Broad River in Madison County has been identified by the State of Georgia as a contaminated stream. Fecal coliform from "nonpoint" sources such as agriculture, wildlife, or septic systems, is present at levels that exceed state standards, and the Georgia Environmental Protection Division (EPD) has contracted the Northeast Georgia Regional Commission to identify ways to improve the watershed.

We have identified several "Best Management Practices" (BMP) to reduce pollution over the short-, medium-, and long-term. Please see the reverse side for more information.

Septic maintenance

NEGRC
Northeast Georgia Regional Commission

Broad River

GEORGIA
Department of Natural Resources

Filter strips

Watering station

Broad River Watershed Management Plan

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Septic maintenance

NEGRC
Northeast Georgia Regional Commission

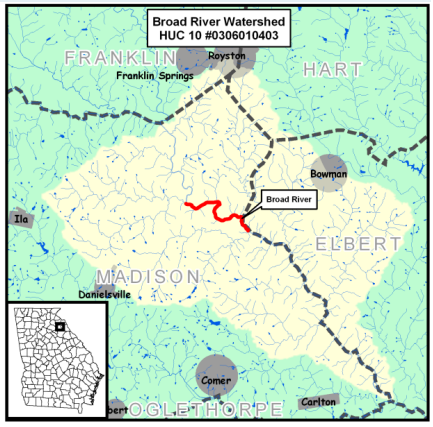
Broad River

GEORGIA
Department of Natural Resources

Filter strips

Recommended Best Management Practices

These BMPs provide landowners and others with tools to improve water quality. EPD administers grant funding to assist with implementation, and other sources of information, such as the County extension office and the Georgia Adopt-a-Stream program, are excellent partners.



Limiting Livestock Access to Riparian Areas and Streams: Best implemented when producers have alternative water sources and shade for their livestock.

Vegetated Buffers/Filter Strips/Swales: Strips of vegetation next to an area of runoff. The runoff flows over the buffer or filter strip to allow sediment to be captured and allow water to be filtered into the soil.

Monitoring Malfunctioning Septic Tanks: Ensure that septic tanks are monitored and maintained through educational programs and/or ordinances.

Stackhouses for Poultry Litter: Poultry growers should consider stacking broiler litter for more than eight days to eliminate fecal coliforms in runoff from land-spread litter.

Wildlife Management: Measures designed to address animal overpopulation or the concentration and infiltration of specific animals into streams and lakes.

Educational Programs and Materials: Communities employ various methods to engage area residents, employers, and developers on the rules and efforts behind maintaining local water quality.

Stream Crossings: Designed to protect water quality and erosion by concentrating animal and livestock crossings over stable access points or structures.

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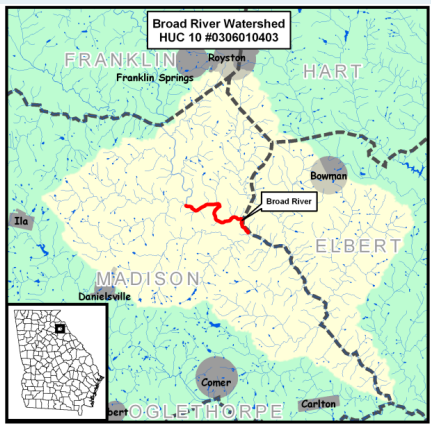


Limiting Livestock Access to Riparian Areas and Streams: Best implemented when producers have alternative water sources and shade for their livestock.

Vegetated Buffers/Filter Strips/Swales: Strips of vegetation next to an area of runoff. The runoff flows over the buffer or filter strip to allow sediment to be captured and allow water to be filtered into the soil.

Monitoring Malfunctioning Septic Tanks: Ensure that septic tanks are monitored and maintained through educational programs and/or ordinances.

Stackhouses for Poultry Litter: Poultry growers should consider stacking broiler litter for more than eight days to eliminate fecal coliforms in runoff from land-spread litter.

Wildlife Management: Measures designed to address animal overpopulation or the concentration and infiltration of specific animals into streams and lakes.

Educational Programs and Materials: Communities employ various methods to engage area residents, employers, and developers on the rules and efforts behind maintaining local water quality.

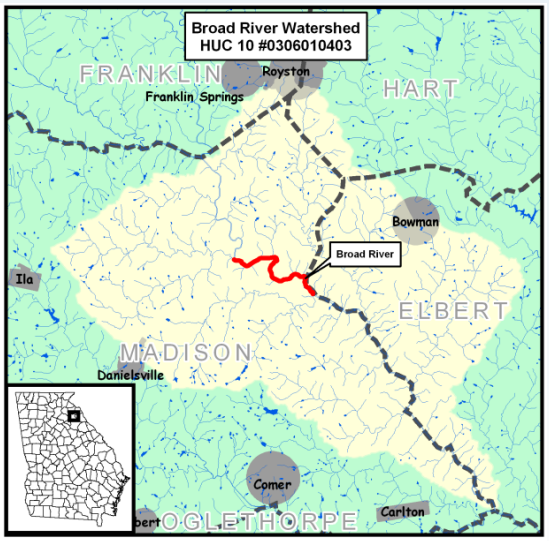
Stream Crossings: Designed to protect water quality and erosion by concentrating animal and livestock crossings over stable access points or structures.

Watering station

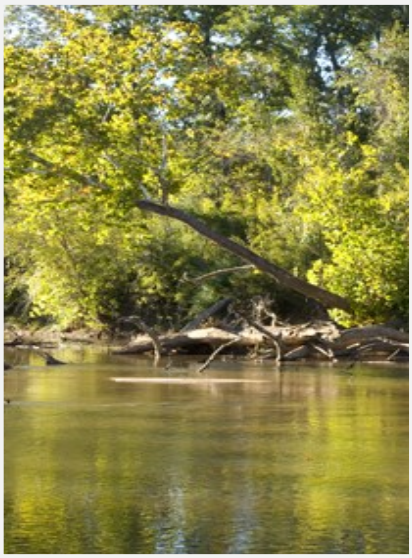
Filter strips

Septic maintenance

Broad River Watershed Management Plan



A five-mile segment of the Broad River in Madison County has been identified by the State of Georgia as a contaminated stream. Fecal coliform from "nonpoint" sources such as agriculture, wildlife, or septic systems, is present at levels that exceed state standards, and the Georgia Department of Natural Resources' Environmental Protection Division (EPD) has contracted the Northeast Georgia Regional Commission to identify ways to improve the watershed.



Broad River

We have identified several "Best Management Practices" (BMP) to reduce pollution over the short-, medium-, and long-term. Please see the reverse side for more information.

NEGRC
Northeast Georgia Regional Commission

Georgia Department of Natural Resources

Recommended Best Management Practices

For the Broad River Watershed

These BMPs provide landowners and others with tools to improve water quality. EPD administers grant funding to assist with implementation, and other sources of information, such as the County extension office and the Georgia Adopt-a-Stream program, are excellent partners.

Limiting Livestock Access to Riparian Areas and Streams

Best implemented when producers have alternative water sources and shade for their livestock.

Vegetated Buffers/Filter Strips/Swales

Strips of vegetation next to an area of runoff. The runoff flows over the buffer or filter strip to allow sediment to be captured and allow water to be filtered into the soil.

Monitoring Malfunctioning Septic Tanks

Ensure that septic tanks are monitored and maintained through educational programs and/or ordinances.

Stackhouses for Poultry Litter

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Stream Crossings

Designed to protect water quality and erosion by concentrating animal and livestock crossings over stable access points or structures.

NEGRC
Northeast Georgia Regional Commission

GEORGIA
Department of Natural Resources

Top 10 Ways to Improve Your Watershed

Broad River, Madison County

1. Install **BMPs** on your property (see reverse)

2. Monitor and service your **septic tank**

3. Alert Georgia EPD, local code enforcement personnel, or the county extension agent to any potentially **problematic activity**

4. Talk with your neighbors and business partners about **healthy watersheds**

5. Become a member of the Broad River **Watershed Association**

6. Keep water in the streams by conserving it at home – **"dilution is the solution"**

7. Pick up and dispose of **pet waste**

8. Test soil before you use **fertilizer** – you might not need it

9. Buffer streams with **native plants and swales**

10. Participate in Georgia's **Adopt-a-Stream** program

Recommended **Best Management Practices**

For the Broad River Watershed

These BMPs provide landowners and others with tools to improve water quality. EPD administers grant funding to assist with implementation, and other sources of information, such as the County extension office and the Georgia Adopt-a-Stream program, are excellent partners.

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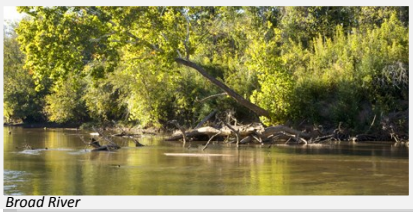
Watering station


Septic maintenance


Filter strips


Broad River

Broad River Watershed Management Plan

A five-mile segment of the Broad River in Madison County has been identified by the State of Georgia as a contaminated stream. Fecal coliform from "nonpoint" sources, such as agriculture, wildlife, or septic systems, is present at levels that exceed state standards, and the Georgia Environmental Protection Division (EPD) has contracted the Northeast Georgia Regional Commission (NEGRC) to identify ways to improve the watershed.

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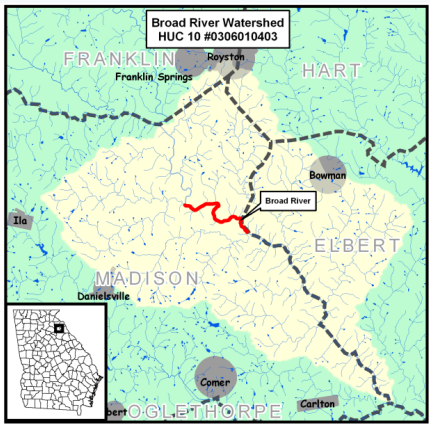
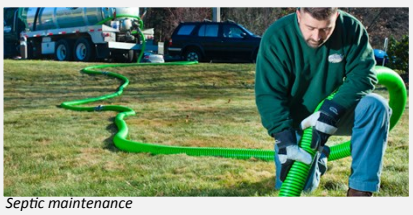
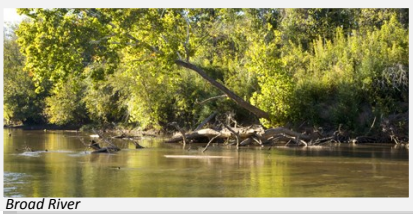



Watering station


Septic maintenance


Filter strips


Broad River

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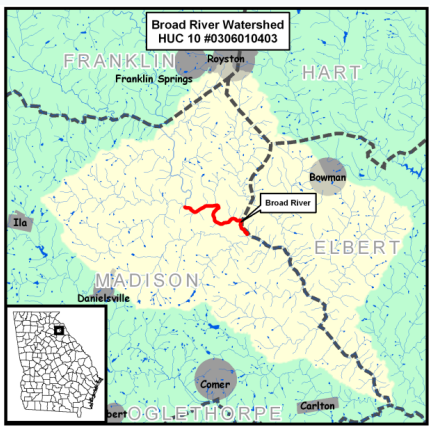

Best Management Practices

For the Broad River Watershed

- Limiting Livestock Access to Riparian Areas and Streams
- Vegetated Buffers/Filter Strips/ Swales
- Monitoring Malfunctioning Septic Tanks
- Stackhouses for Poultry Litter
- Wildlife Management
- Educational Programs and Materials
- Stream Crossings

More information on these BMPs, and on the Watershed Management Plan, can be found at www.negrc.org.

NEGRC Northeast Georgia Regional Commission

GEORGIA Department of Natural Resources

Best Management Practices

For the Broad River Watershed

- Limiting Livestock Access to Riparian Areas and Streams
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NEGRC Northeast Georgia Regional Commission

GEORGIA Department of Natural Resources

Improving YOUR Watershed

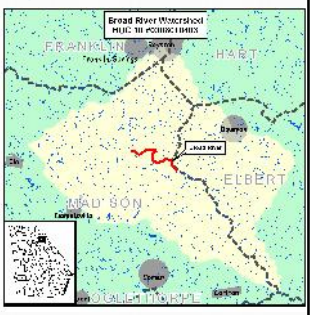
Broad River, Madison County (GA)

prepared by the Northeast Georgia Regional Commission with funding from the Georgia Department of Natural Resources' Environmental Protection Division

NEGRC GEORGIA

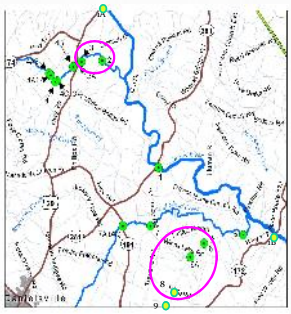
What's Happening?

- 1997 data: fecal coliform contamination
- 2002 data: listed as impaired
- 2007: planning begins
- 2014: Watershed Management Plan (WMP)



What/Where are the Problems?

- Fecal coliform sources:
  - Agriculture
  - Residential
  - Wildlife
- Two main locations of significant "hot" spots:
  - Shiloh Cr. between Manley Martin Rd. and US 29
  - Little Scull Shoal Cr. between Coile Rd. and Duffell Martin Rd.



What BMPs Should I Consider?

Limiting Livestock Access to Riparian Areas and Streams
Best implemented when producers have alternative water sources and shade for their livestock

Vegetated Buffers/Filter Strips/Swales
Strips of vegetation next to an area of runoff. The runoff flows over the buffer or filter strip to allow sediment to be captured and allow water to be filtered into the soil.

Monitoring Malfunctioning Septic Tanks
Enact septic tank cleanout program ordinances and septic tank failure detection and correction programs or ordinances.

Stackhouses for Poultry Litter
Stackhouses provide an effective means for storing and managing chicken litter and might minimize the volume of litter applied on local fields. Poultry growers should consider stacking broiler litter for more than eight days to eliminate fecal coliforms in runoff from land-spread litter.

Wildlife Management
This is the general term for measures designed to address animal overpopulation or the concentration and infiltration of specific animals into streams and lakes. This can include the forced removal of animals, the introduction of measures to deter animals, or adjustments in hunting policies.

Educational Programs and Materials
Communities employ various methods to engage area residents, employers, and developers on the rules and efforts behind maintaining local water quality.

Stream Crossings
Designed to protect water quality and erosion by concentrating animal and livestock crossings over stable access points or structures.

Top 10 Ways to Help Improve Your Watershed

1. Install BMPs on your property
2. Monitor and service your septic tank
3. Alert Georgia EPD, local code enforcement personnel, or the county extension agent to any potentially problematic activity
4. Talk with your neighbors and business partners about healthy watersheds
5. Become a member of the Broad River Watershed Association
6. Keep water in the streams by conserving it at home – "dilution is the solution"
7. Pick up and dispose of pet waste
8. Test soil before you use fertilizer – you might not need it
9. Buffer streams with native plants and swales
10. Participate in Georgia's Adopt-a-Stream program

…And One for Good Measure

11. Volunteer to give this presentation at your organization's next meeting!

Appendix D

Suggestions for Working with Landowners/Managers

The following suggestions are presented in response to a stakeholder request to provide information related to contacting and coordinating with landowners and property managers to initiate the BMP implementation process.

1. Prioritize landowners based on criteria outlined in the Watershed Management Plan, in consultation with stakeholders and Partnership Advisory Council members listed in the WMP, including the county extension agent, NRCS and GSWCC for agriculture; county code enforcement officer and public health officials for septic systems; and chamber of commerce officials, county planning and zoning staff, and other local organizations for business. Also, weigh previous interest in water quality improvement and/or water resource management when making decisions.
2. Do your homework: learn about the parcel(s) and how the landowner/manager makes use of the land.
3. Find a mutual friend or contact and set up an appointment to meet, face-to-face, either on the property or at a neutral location.
4. Ask questions, share information, and become better acquainted with the person and the property.
5. Try to build a rapport and establish common ground (it is likely that you both want clean water, even if for different reasons).
6. Talk informally about the different BMPs recommended in the Watershed Management Plan, and suggest that the landowner/manager discuss which are most likely to be effective with the county extension agent, the public health department staff, and/or other experts.
7. Mention, if applicable, that grant funding might be available to share the cost of implementing recommended BMPs.
8. Leave with a list of to-dos for each party, and follow through on yours. These might include further investigation of implementation techniques and/or costs, securing letters of commitment or interest related to grant applications, assisting with grant application development processes, or other tasks.

Appendix E

Stakeholder List

Madison County Commission Chair	Anthony Dove
Madison County Commissioner (Dist. 2)	Dewitt Bond
Madison County Commissioner (Dist. 4)	John Pethel
Madison County Clerk	Rhonda Wooten
Madison County Planning & Zoning Administrator	Linda Fortson
Madison County Cooperative Extension Agent	Adam Speir
Madison County Code Enforcement Officer	Jack Huff
Madison County Emergency Management Agency Director	Johnny Bridges
Madison County Sherriff's Office Chief Deputy	Shawn Burns
Madison County Health Department	Beth Heath
Madison County School System Superintendent	Allen McCannon
City of Comer Clerk	Steve Sorrells
City of Danielsville Mayor	Todd Higdon
City of Danielsville Clerk	Susan Payne
City of Carlton Mayor	Rufus Kidd
Watson Mill State Park Manager	Jerry Cook
Madison County Chamber of Commerce Director	Marvin White
Broad River Watershed Association Chair and Board Members	Various
Madison County Cattleman's Association	Trey McCay
Georgia EPD Communication/Outreach Specialist	Mary Gazaway
Georgia River Network Executive Director	April Ingle
Georgia River Network Policy Director	Chris Manganiello
Georgia River Network Community Program Coordinator	Gwyneth Moody
Georgia River Network Watershed Support Coordinator	Jesslyn Shields
Oconee River RC&D Executive Director	Tim Savelle
Georgia Forestry Commission	Brannon Carey
Georgia Forestry Commission	Carl Melear
Georgia Forestry Commission	Wesley Moss
NRCS Commerce	Carol Boss

Appendix F

Micro-watershed Tutorial

A tutorial presenting a “how-to” guide to constructing micro-watersheds similar to those found in this WMP using ArcGIS follows.

MICRO-WATERSHED DELINIATION FOR DETERMINING POTENTIAL ORIGINS OF NON-POINT SOURCE POLLUTION IN RIVERS AND STREAMS USING GIS

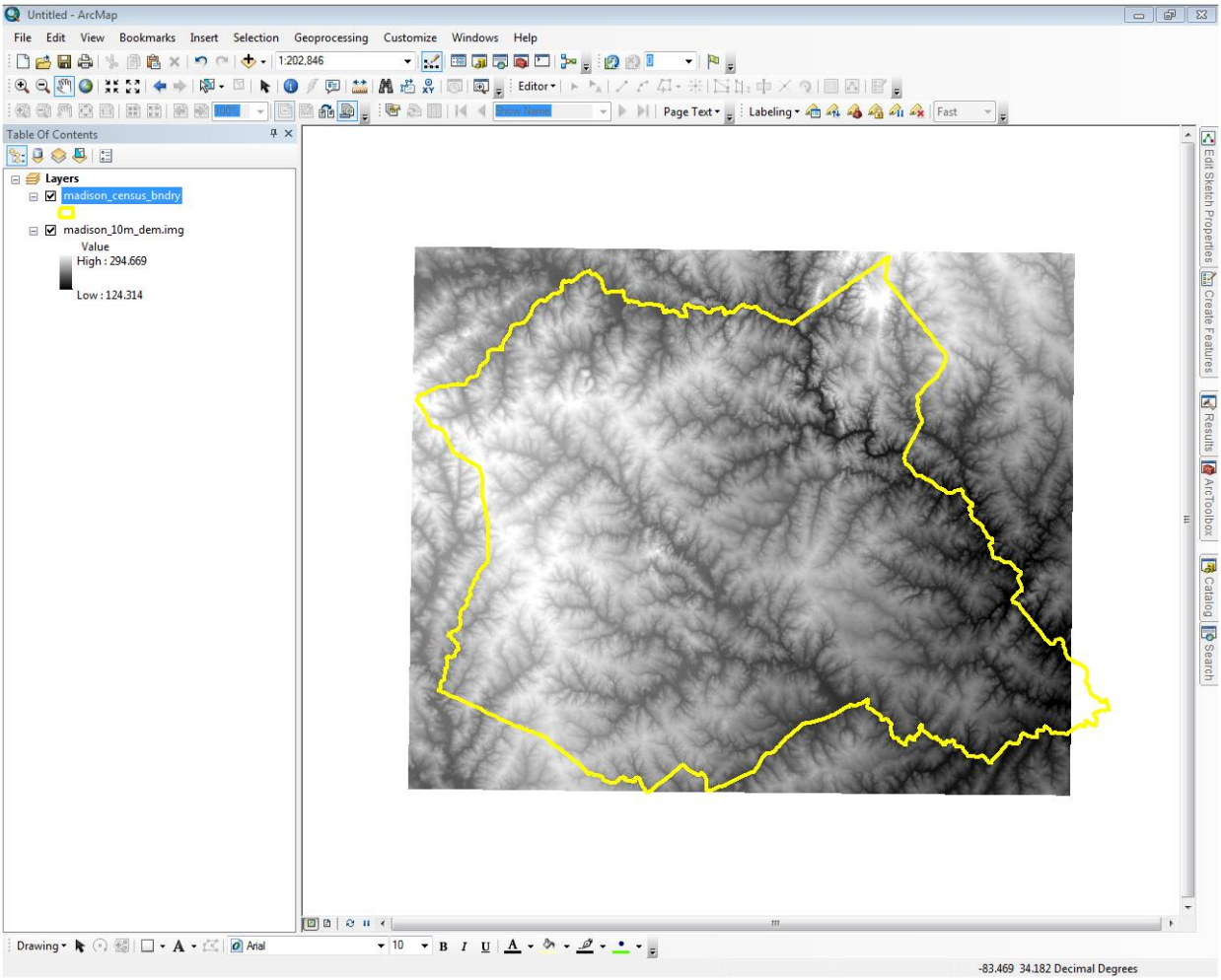
4/23/2014

NORTHEAST GEORGIA REGIONAL COMMISSION. ATHENS, GEORGIA

Adapted from University of Washington, School of Forest and Environmental Sciences, ESRM 250, Introduction to Geographic Information Systems in Forest Resources, Lab titled "Exercise: Watershed Delineation" dated 5/24/2012 (last retrieved 3/11/2014).
http://courses.washington.edu/gis250/lessons/hydrology/exercise/

This analysis requires a computer with ArcMap's Spatial Analysis Extension.

Load a Digital Elevation Model (DEM) into ArcMap. The higher resolution the DEM the better (e.g. 10 meter resolution is better than a 30 meter resolution, and so on). It should be in ERDAS Imagine (*.IMG) format.



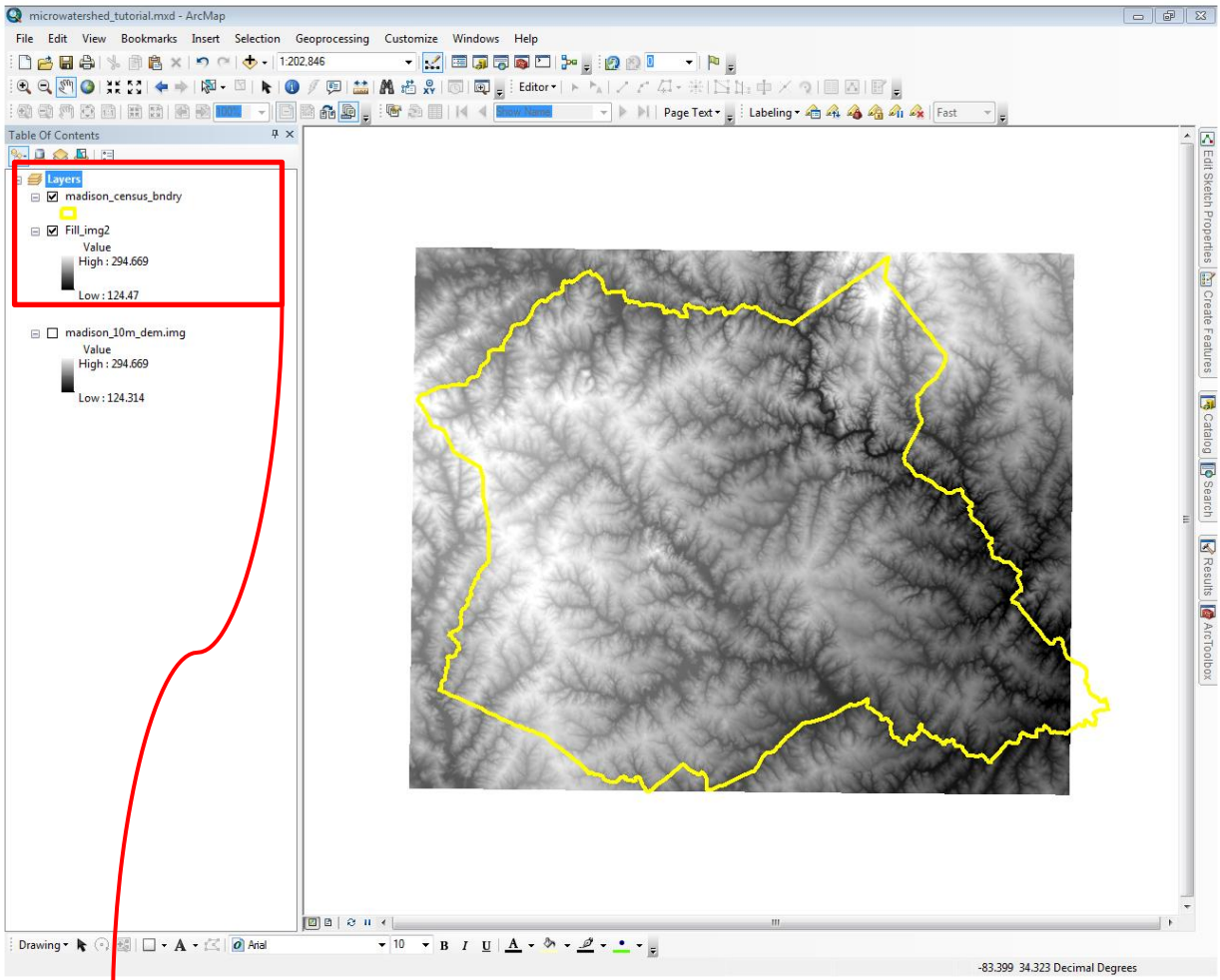
Here a 10 meter DEM for Madison County, Georgia has been loaded. (The far east corner that is cut off for now, this is in a different 7.5" Quadrangle boundary but is not necessary for this tutorial).

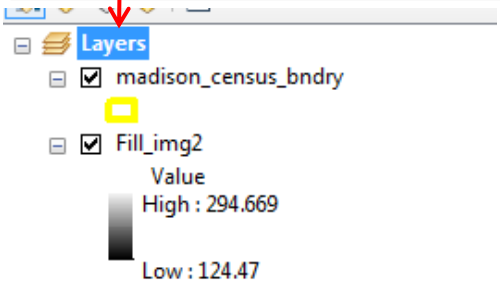
To begin delineating the micro-watersheds, a series of analyses needs to be done. This is done by a series of automatic processes in ArcToolbox.

The first step is to render a Depressionless DEM. This gets rid of any anomalies in the DEM that might not show flow.

Go to ArcToolbox→Spatial Analyst Tools→Hydrology→Fill

Load the DEM file into "Input surface raster", accept default "Output surface raster" value, and click "OK". Generating this file may take a few minutes. The resulting file name will begin with "Fill_ ").



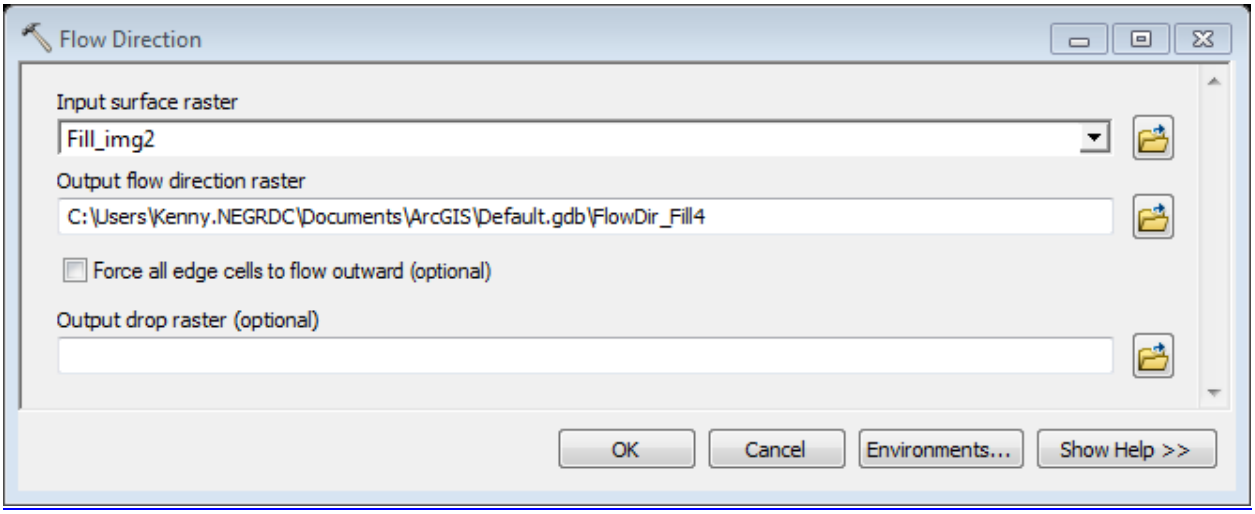


At this point, the original DEM can be removed from the workspace as this is what the analysis will be conducted from (it won't hurt to leave it in, but turned off. Removing it helps keep the workspace less cluttered).

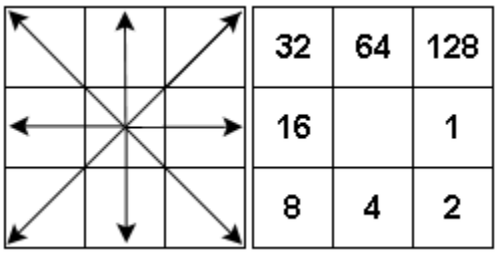
The next step is to determine the flow direction, or what way water will flow when it hits the land at any given point.

Go to ArcToolbox→Spatial Analyst Tools→Hydrology→Flow Direction

Load the "Fill" image (which was generated in the previous step) into "Input surface raster", accept default in "Output flow direction raster", and click OK.

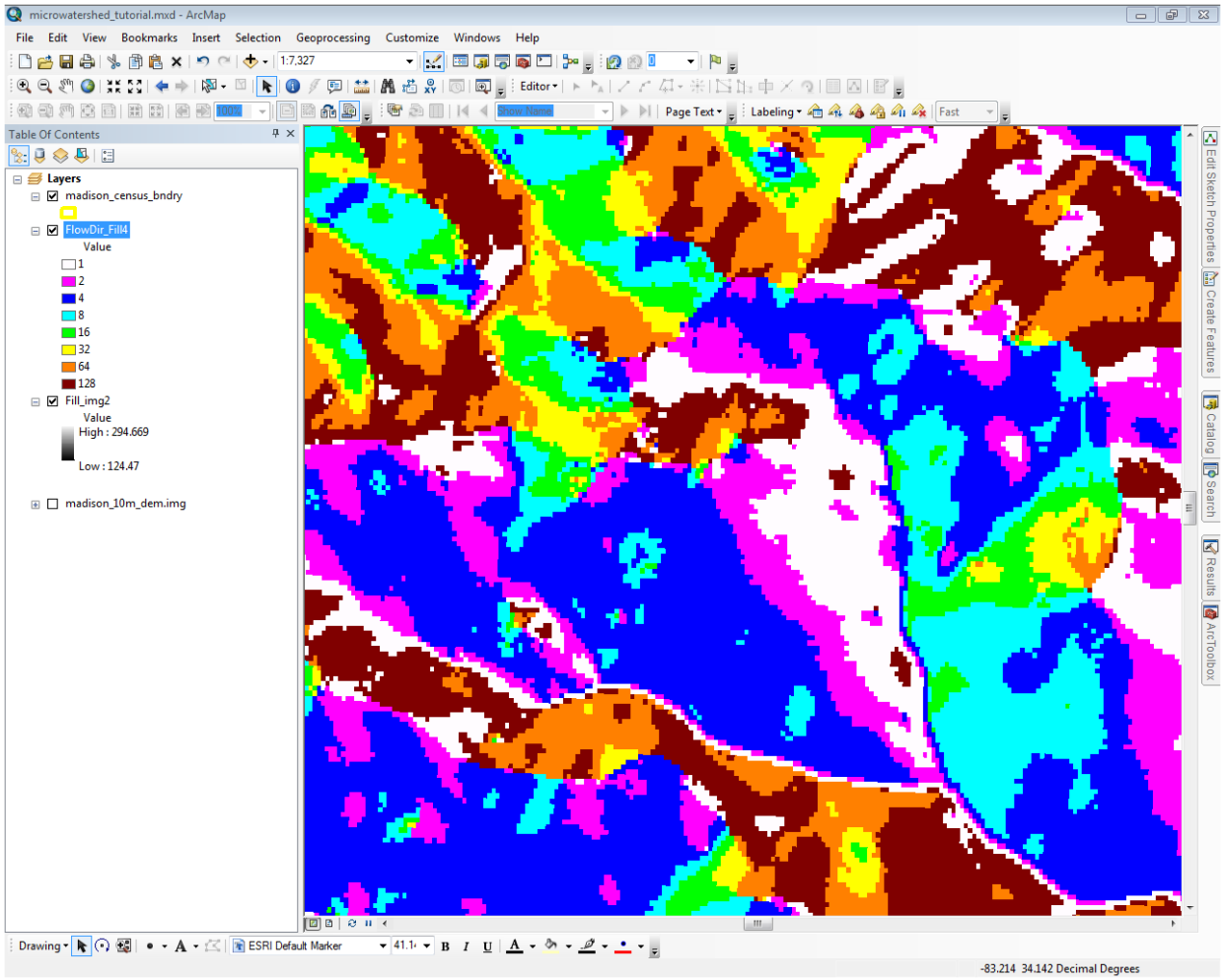


The resulting file "FlowDir_" shows the compass direction to where which a point flows, and is coded automatically as 1 (East), 2 (Southeast), 4 (South), 8 (Southwest), 16 (West), 32 (Northwest), 64 (North), or 128 (Northeast



(Univ. of Wash.)

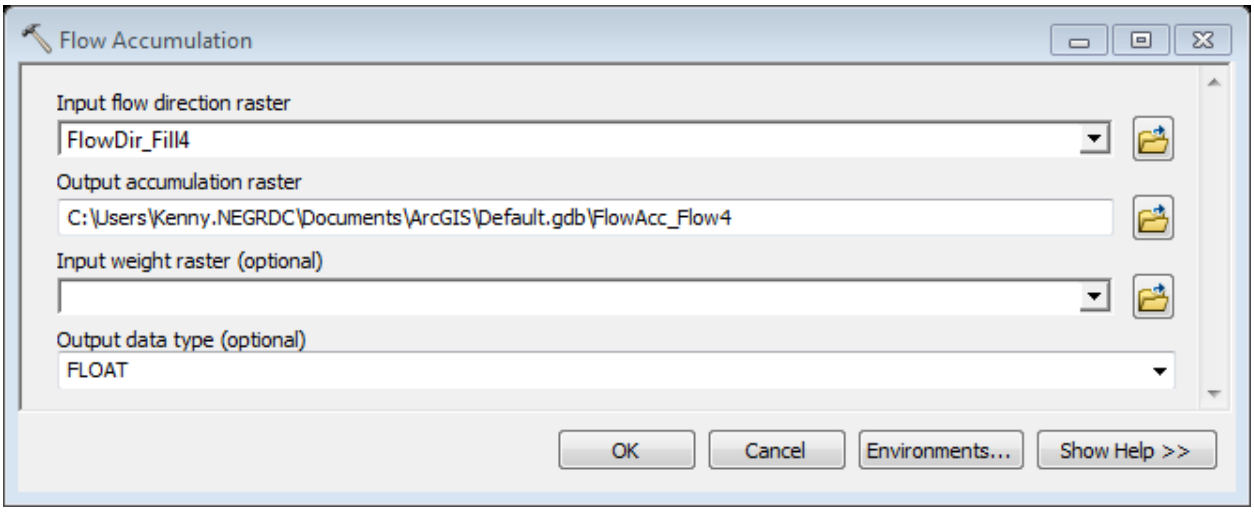
The final image will look like this



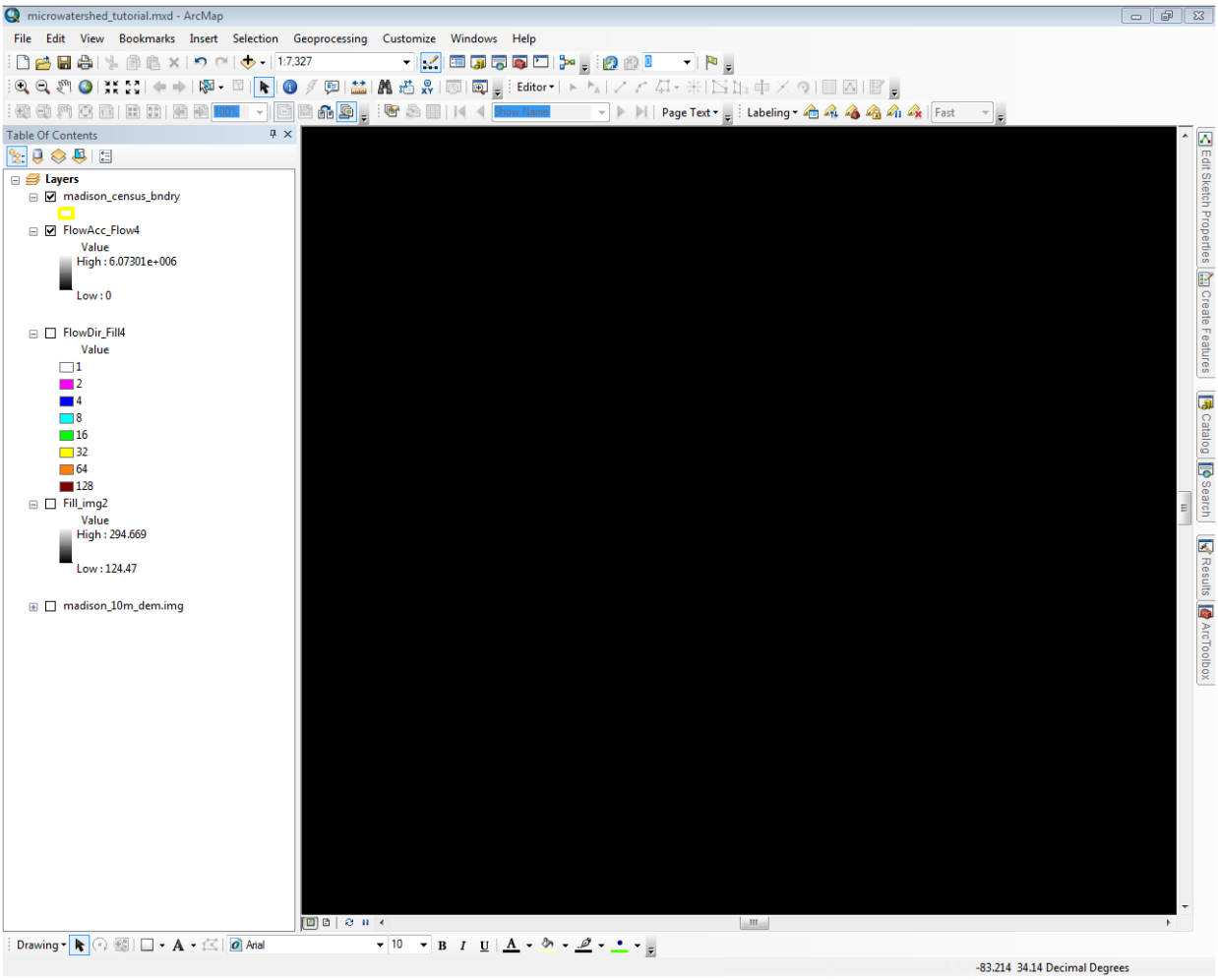
From here, generate a Flow Accumulation. This determines areas of high flow, or low spots to where water is flowing.

ArcToolbox→ Spatial Analyst Tools→Hydrology→Flow Accumulation

Load "FlowDir-" in "Input flow direction raster", accept defaults, and click OK. (This may take a couple of minutes)



The result ("FlowAcc_") will be something that looks like this—a completely black image:

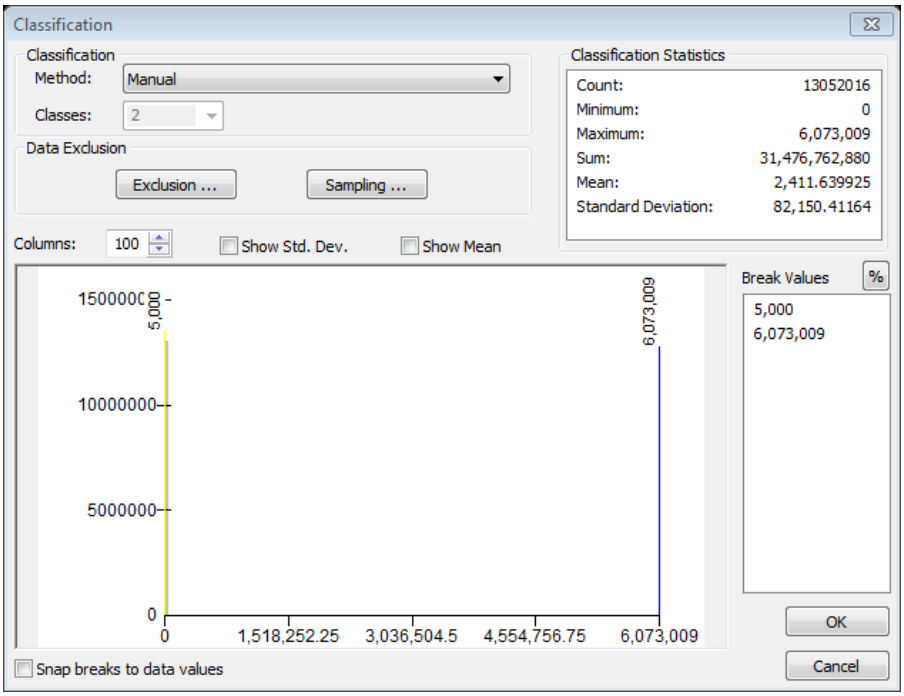


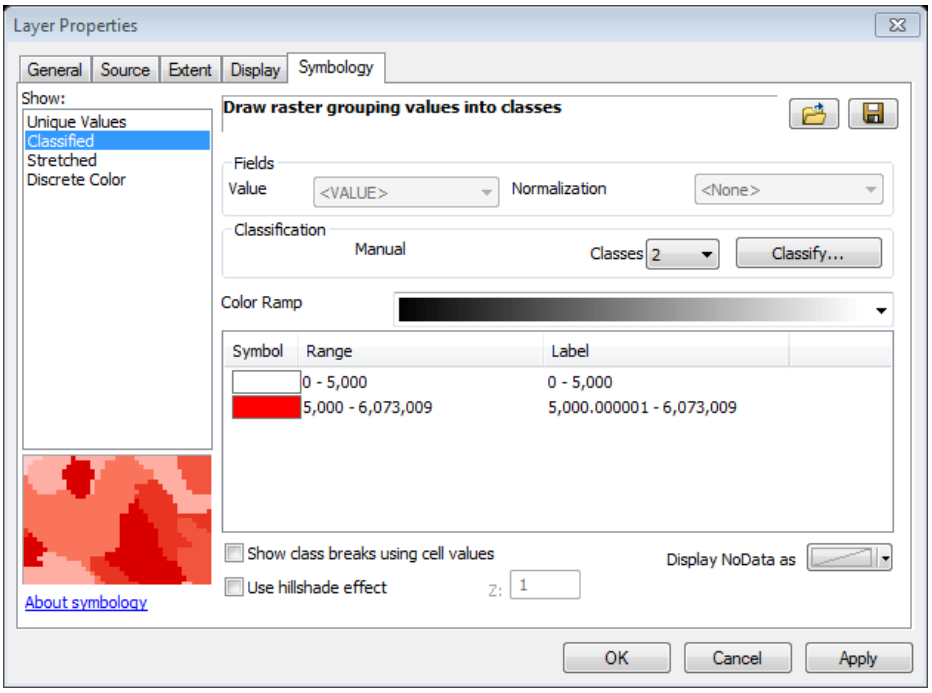
To display the flow accumulation (which is essentially streams, creeks, rivers, etc.), reclassify the DEM.

Right click→Properties→Symbology→Classified→Classify..

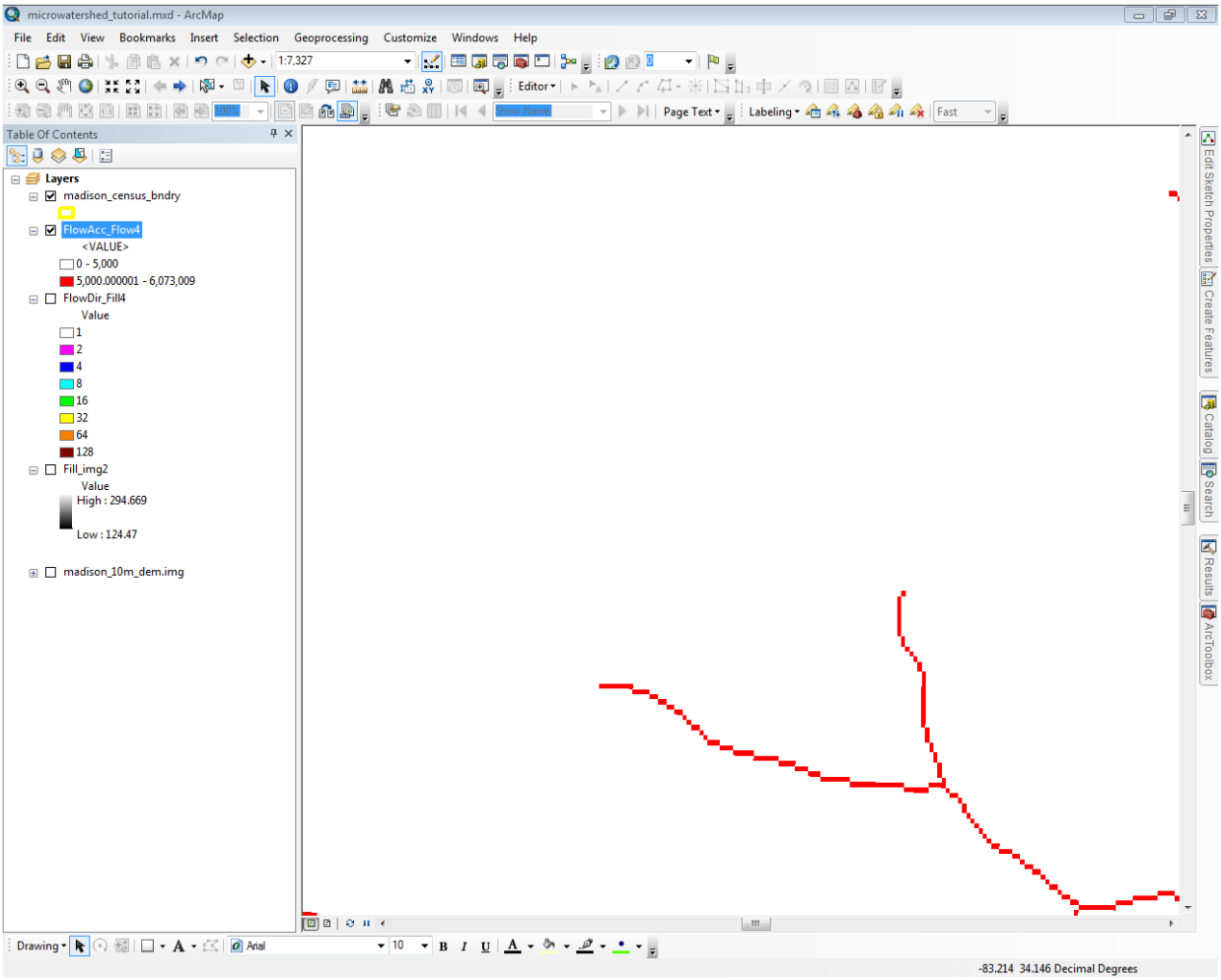
Under Classification, Method, select "Natural Breaks (Jenks)", and Classes, "2". Change Break Values to 5000 for the first, then accept the default for the second, click OK. It may automatically change Classification Method" to "Manual", but that won't impact results.

Back in Layer Properties, change the first value (will probably show as black) to white by double clicking, then selecting white on the color table. Change the second value to red by the same method. Click OK.



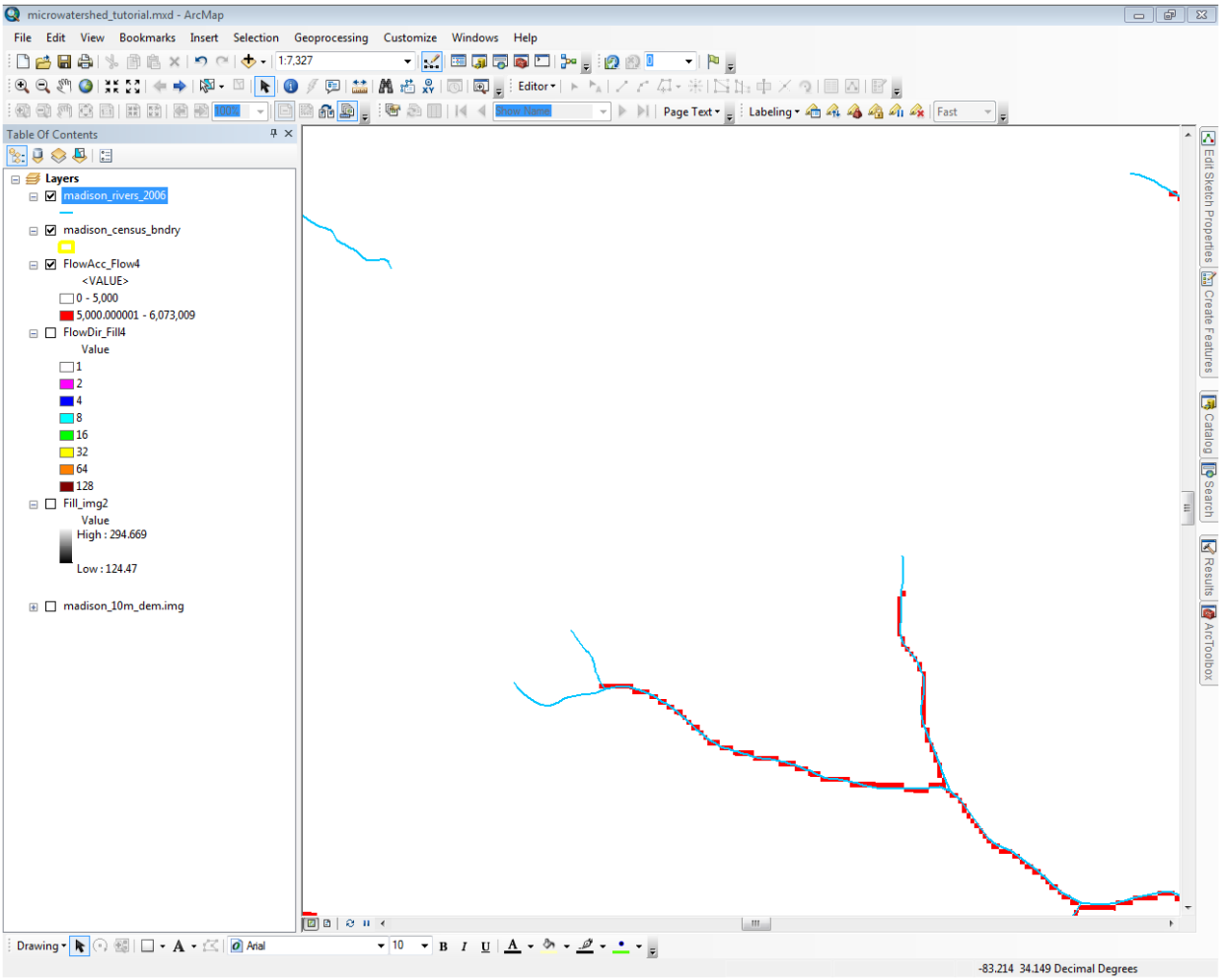


The resulting file will look something like this:



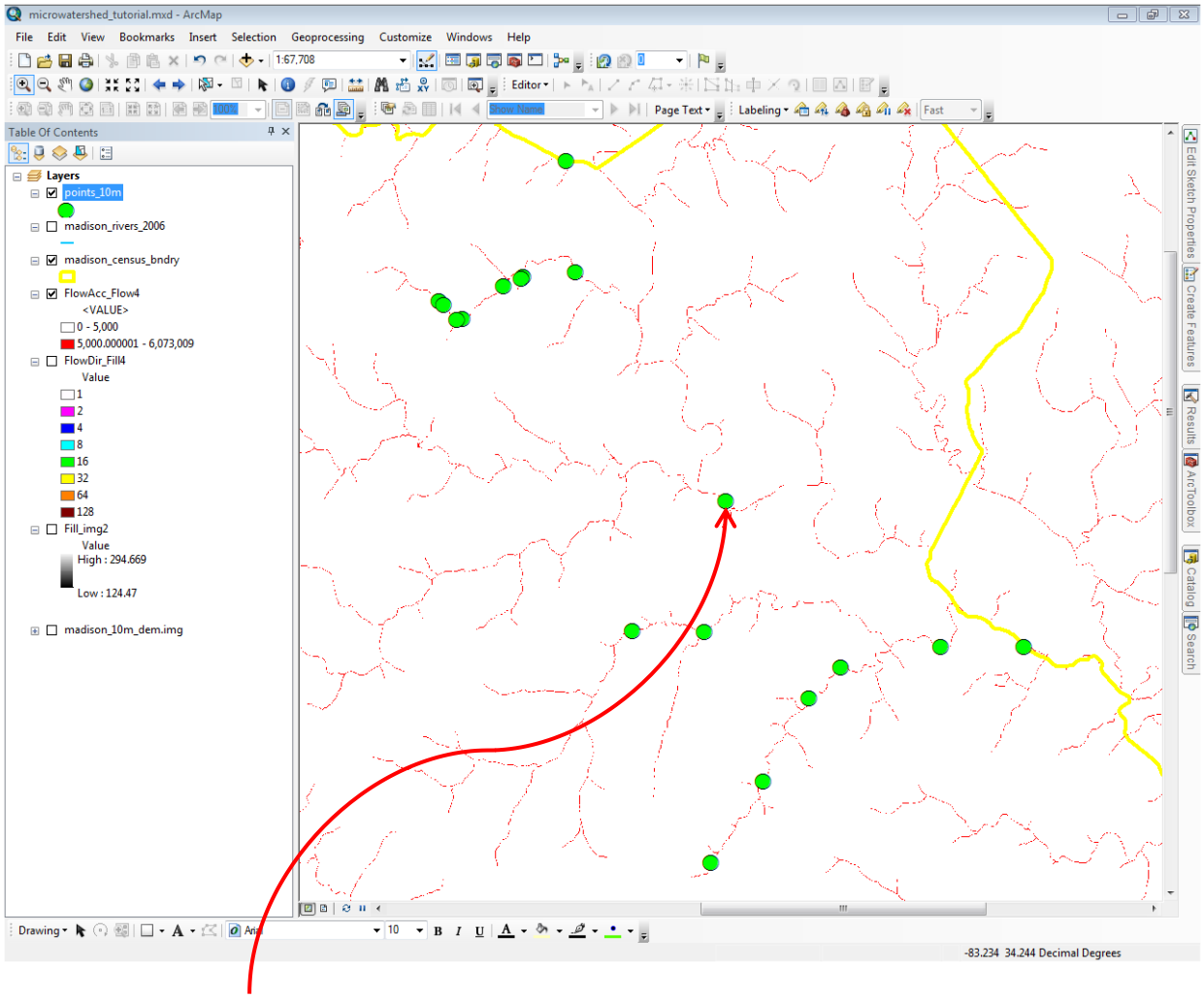
The resulting red line depicts streams, rivers, creeks, etc., basically anywhere water flows.

Compare the red lines just generated with a vector stream file (loaded in blue) in the image below. It's not an exact match— that depends much on precision of data, classification, etc.—but is pretty close otherwise.



The next step is to determine the micro-watersheds based on sampling points. The sampling points need to be loaded into ArcMap to determine what areas flow to them, thus making it possible to determine with some confidence an area from where potential non-point source pollution is flowing.

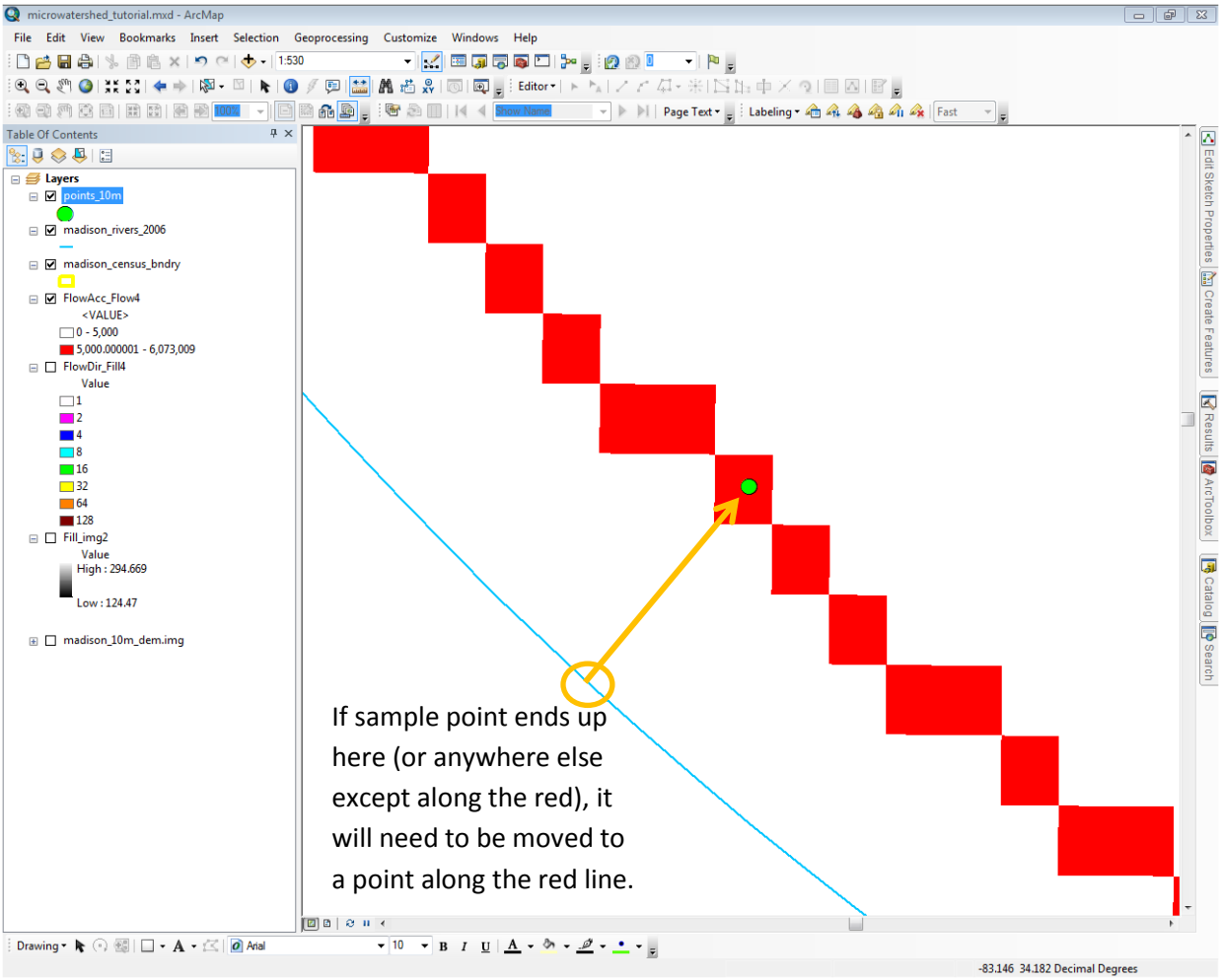
Load sampling points (a simple adding a shapefile, geodatabase feature class, etc.). The sampling points for this particular project are the green circles titled “points_10m”, but they can be named whatever they need to be for the particular project.



The next few steps will produce a file for the entire collection of sampling points, but will zoom into this one for display purposes.

Note: It's necessary at this point that the points lie along the processed DEM/Raster file, and not the vector/stream data since the watersheds are determined not by vector, but rather raster data—in this case, the recently processed "FlowAcc_" file . This may require moving the points slightly, and may be good to generate a temporary file so as to not create location errors in the sampling points.

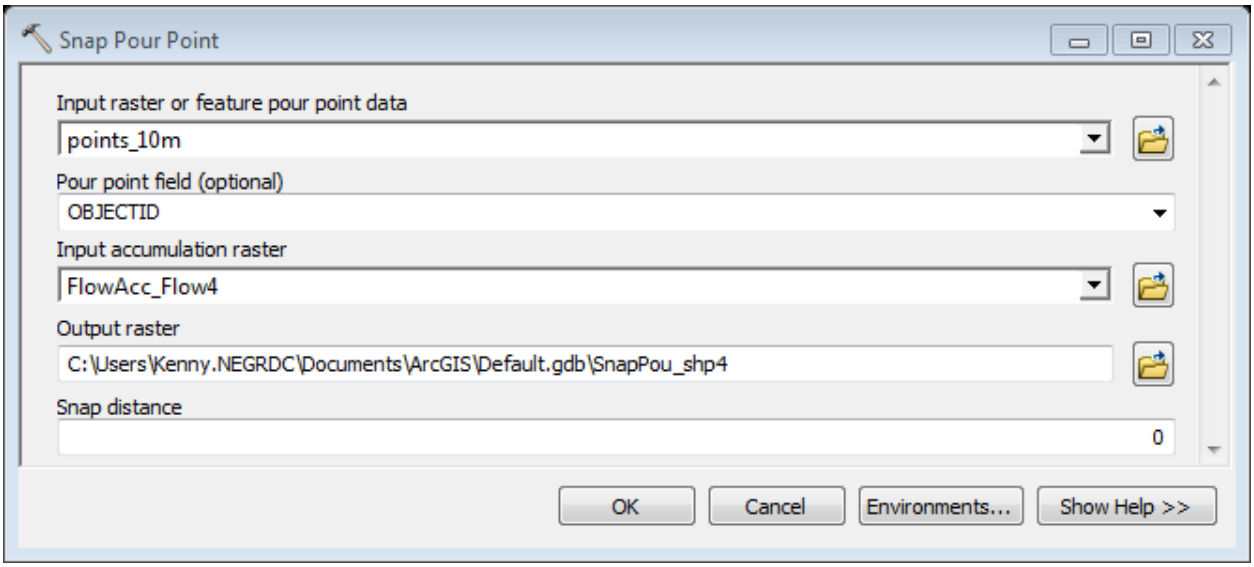
In other words, the green dot needs to be along the red squares, and not along the blue line, in the white area, or so forth (see below)



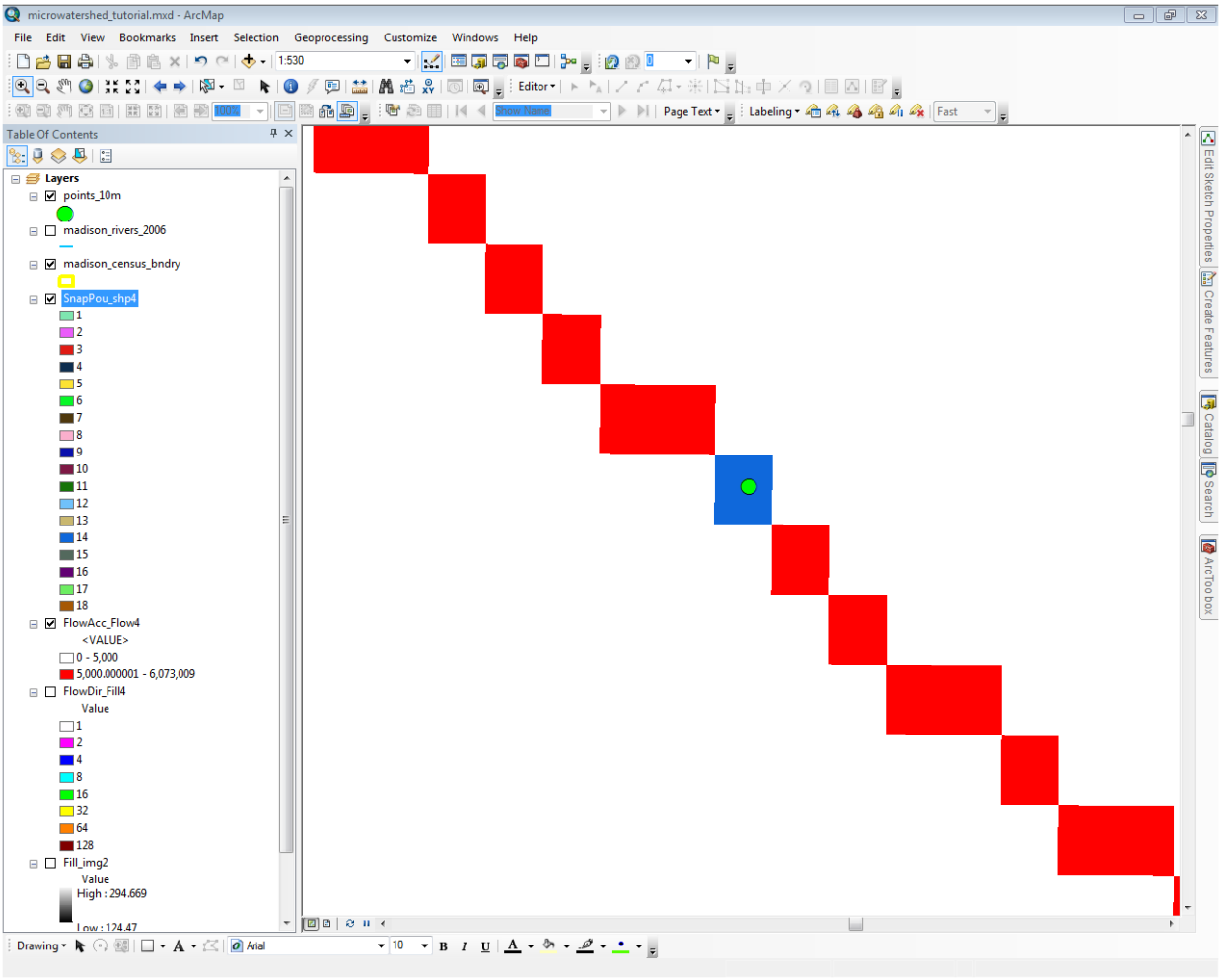
Now, it is necessary to convert the sampling point vector file to a sampling point raster file , or a pour points file.

ArcToolbox→Spatial Analyst Tools→Hydrology→Snap Pour Point

Load the points shapefile (in this case, points_10m) into “Input raster or feature pour point data”, then the flow accumulation file, “FlowAcc-“, file into “Input accumulation raster” Accept defaults, click OK.



This should run quickly—depending on the number of pour points. It's generated one raster cell for each vector point (or one raster cell for each point in "points_10m"). The resulting file is something like "SnapPou_". (Displayed as the blue cell below):

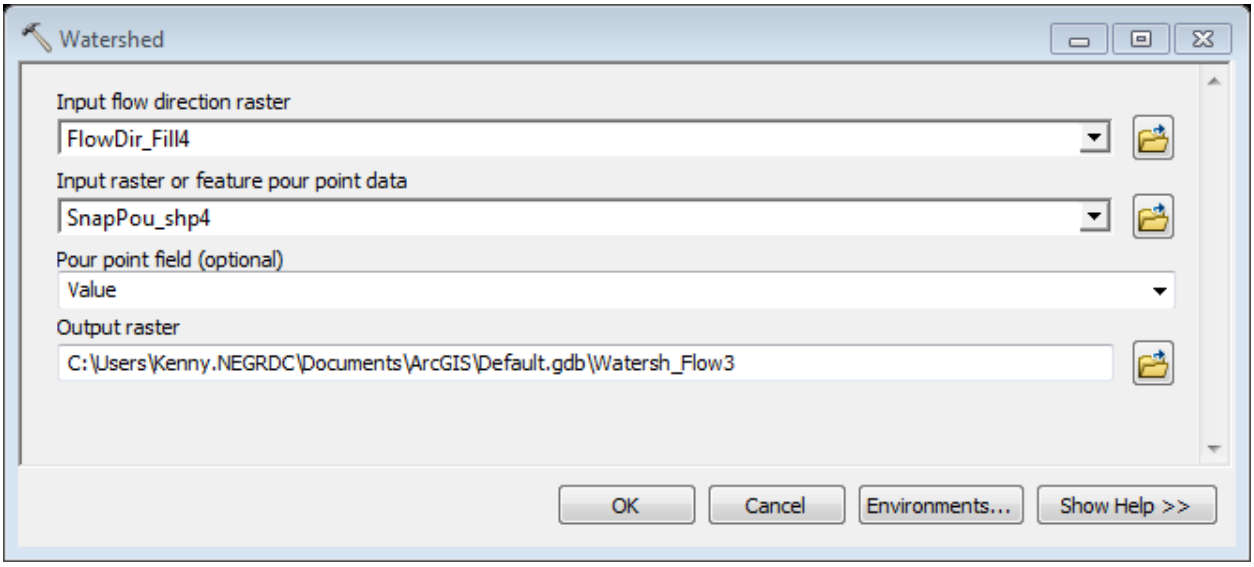


It automatically assigns the number based on the OBJECTID field from the original point file. It may be necessary to change this later to suit the project's needs once a shapefile/feature class is generated for the micro-watersheds. Now, all the processing has been done necessary to generating the micro-watersheds.

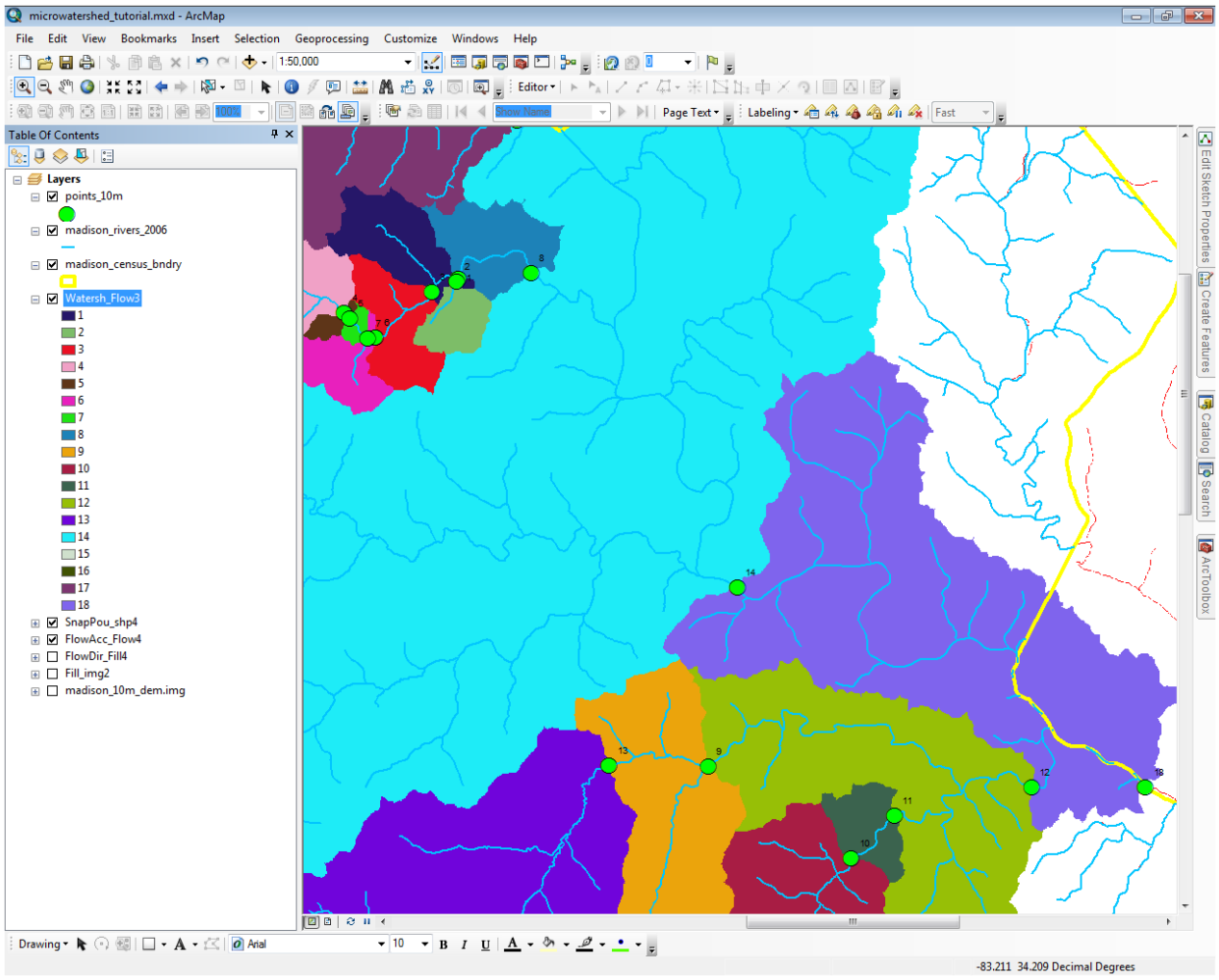
ArcToolbox→Spatial Analyst Tools→Hydrology→Watershed

Load the Flow Direction raster ("FlowDir_") into "Input flow direction raster"
Load the "SnapPou-" into "Input raster of feature pour point data" (the raster version, not the vector

version). Accept all defaults, click OK.

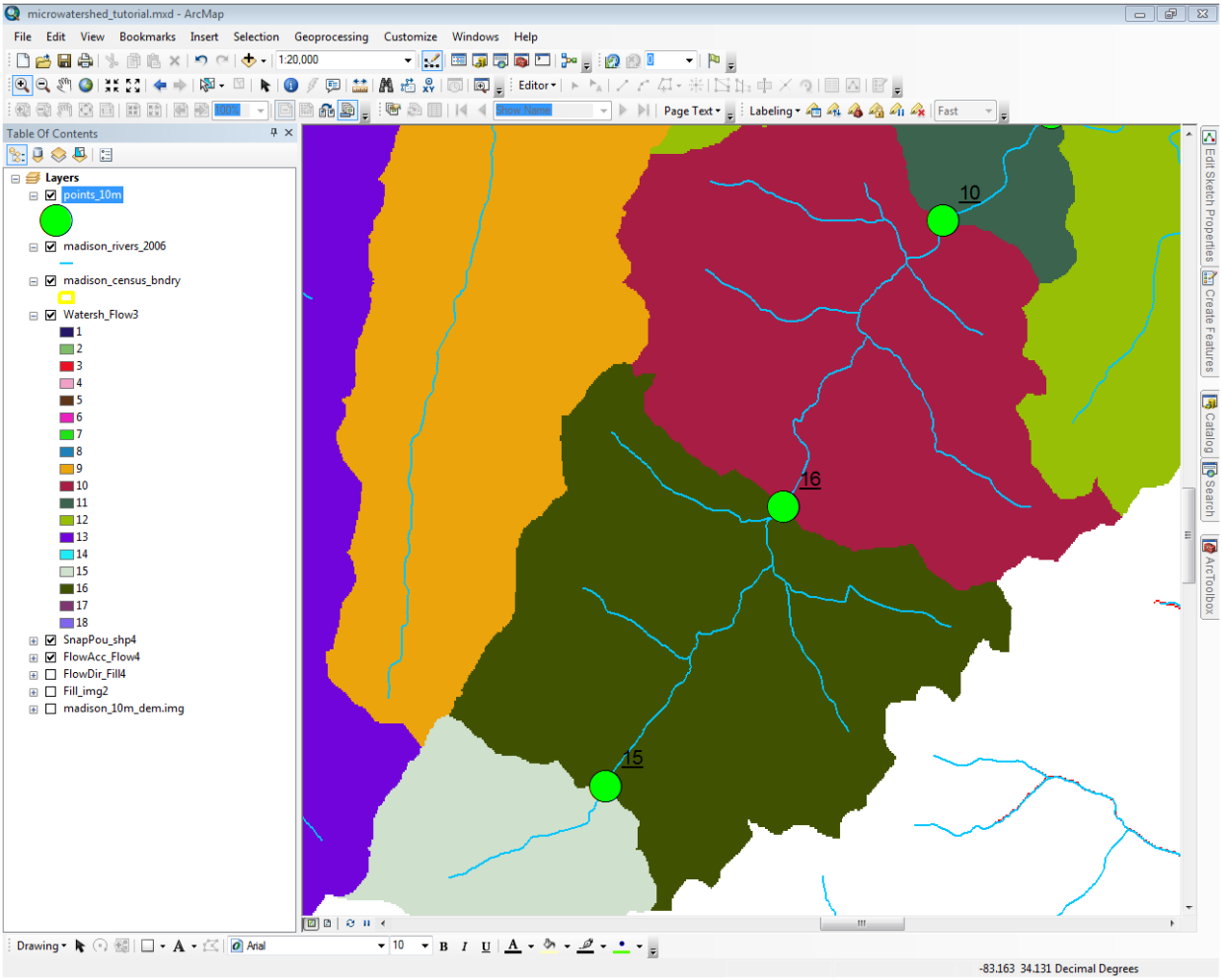


The result will look like this (zoomed back out to a smaller scale):



These are the micro-watersheds for this particular project.

This is what they look like zoomed into to a few of the smaller micro-watersheds (the light blue lines are the streams/rivers/creeks, etc.).



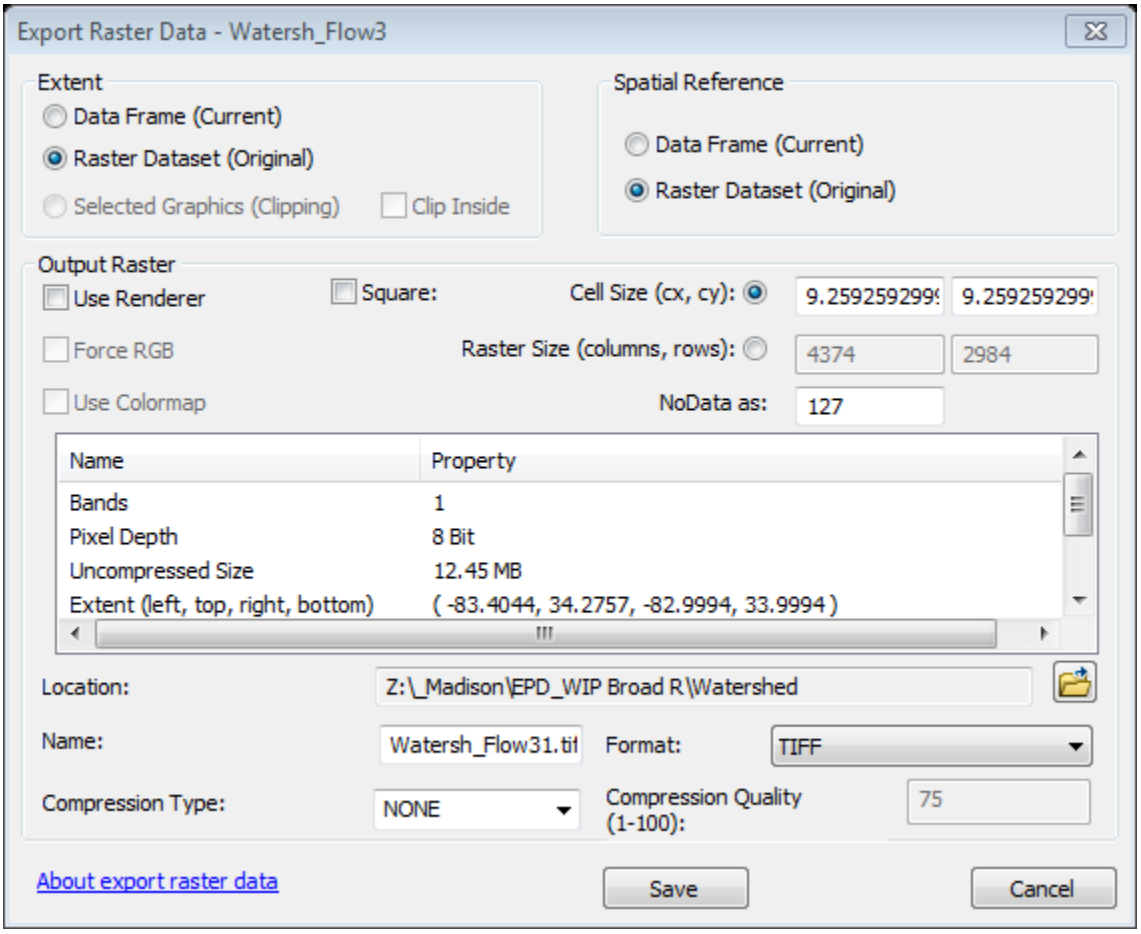
Point 15 receives all water from its micro-watershed (in grey) before flowing into 16's micro-watershed (dark green) which receives all water from its micro-watershed (dark green) before flowing into 10's micro-watershed (dark pink) which receives all water from its micro-watershed (dark pink) and so on successively downstream eventually into the Broad River, eventually into the Savannah River, and eventually into the Atlantic Ocean.

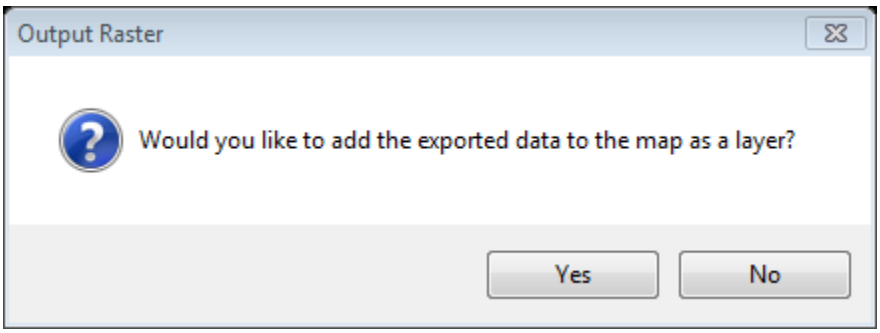
Extra Step 1—Exporting for further and future analysis:

Depending on project requirements, it may be necessary to export the raster file so you can access it later:

Right click the "Watersh_" in the table of contents, then Data→Export Data

Set “Location” to wherever it would best suit the project, and otherwise accept defaults, click “Save”, then “Yes” on the “Output Raster” window that shows up.



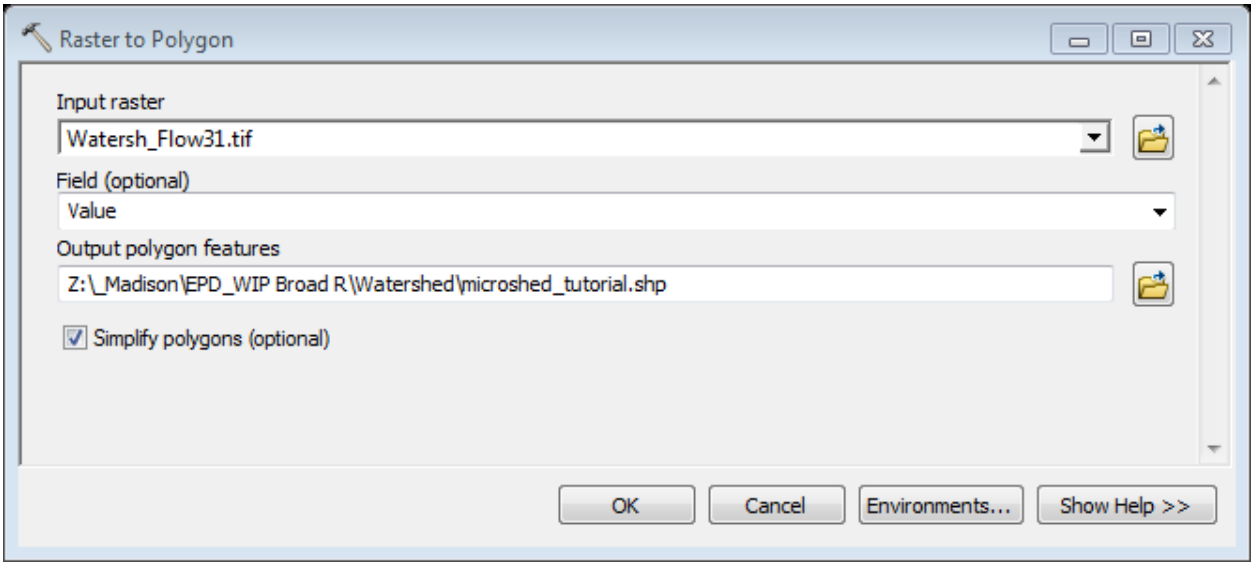


Extra Step 2—Exporting to vector file for easier analysis and calculations:

The project may necessitate conversion to a vector file to ease in analysis later on (area calculations, selection, etc.).

ArcToolbox→Conversion Tools→From Raster→Raster to Polygon

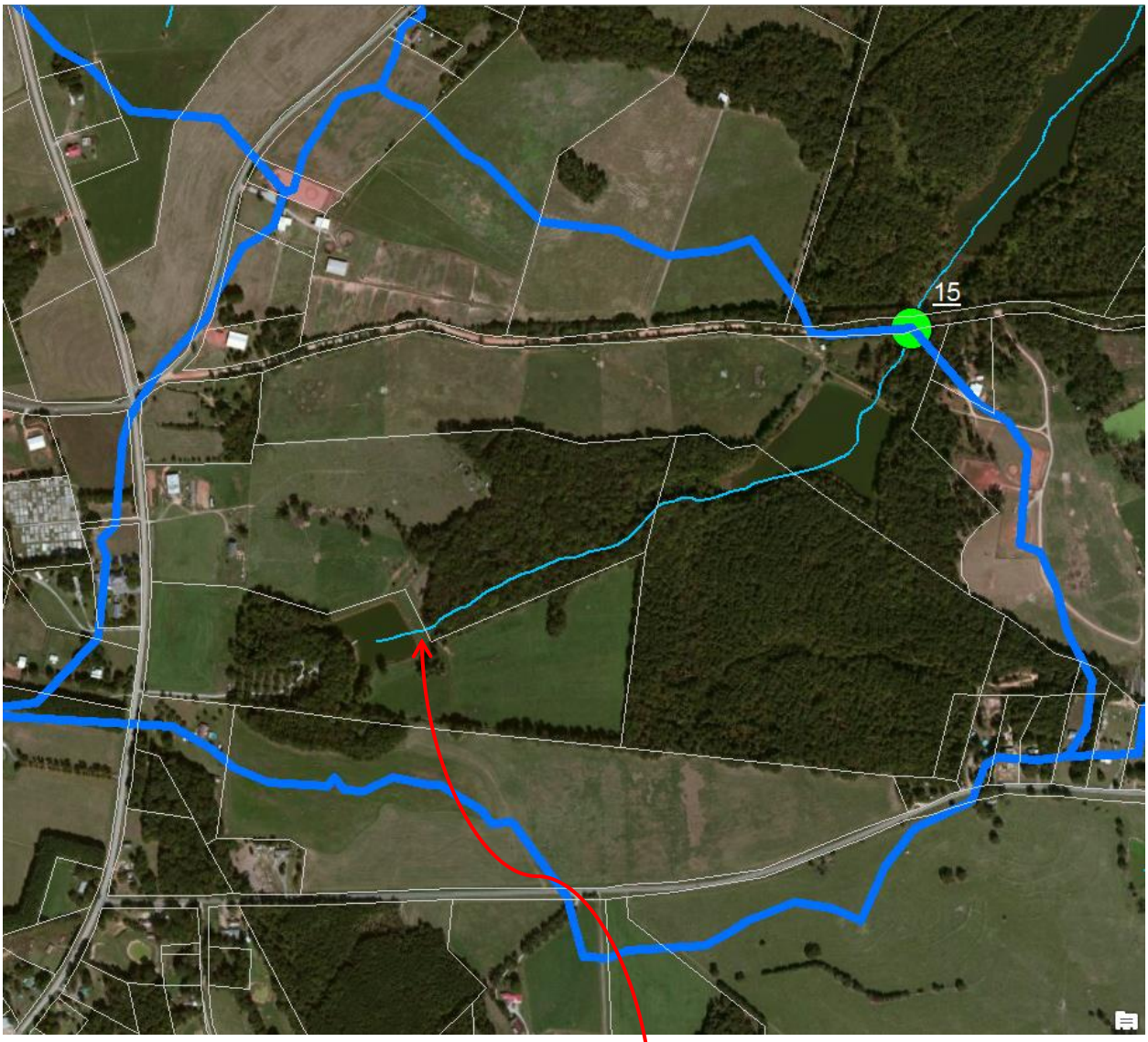
Load the saved (or resulting) raster, the "Watersh_" file as "Input raster", put a convenient saving location in the "Output polygon features" field, accept defaults, and click "OK"



This generates a shapefile/feature dataset that can be used for overlaying on imagery, parcel data, or whatever data may be available to determine, for example from this project, potential sources of water pollution.

Example below: (zoomed to the micro-watershed for sampling point 15)

The area outlined in blue is Sampling Point 15's Micro-watershed. If upon sampling point 15, you were to notice a high level of pollutants, you could have a reasonable idea of what might be generating it, and contact property owners to discuss mitigation opportunities with them.



In this case, *if* 15 showed high levels of pollutants, notice there are several large, cultivated parcels (outlined in grey) in the micro-watershed. There *MIGHT* be cattle farms where cattle are wading in the stream here*

*The data may or may not show high pollutants for this particular micro-watershed. This is just an example. Further analysis, better imagery, site visits, local knowledge, etc. will be necessary to help with confidence determine causes of the pollutants.